UNIVERSITY OF NATAL

PIETERMARITZBURG
SOUTH AFRICA

WATTLE RESEARCH INSTITUTE

South African Wattle Growers' Union — University of Natal —
Union Department of Forestry

REPORT FOR 1958–1959

(TWELFTH YEAR)

OCTOBER, 1959

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The Wattle Research Institute, 1959.

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COMMITTEE OF CONTROL OF THE INSTITUTE

Appointed by the South African Wattle Growers' Union (3):

S. Clegg, Esq. (*Chairman*).
Major C. J. J. Crowe (*Vice-Chairman*).
S. J. F. Nuss, Esq.

Appointed by the University of Natal (2):

Professor A. J. W. Bayer, D.Sc.
Principal E. G. Malherbe, M.A., Ph.D., LL.D.
Alternate: H. H. Cornell, Esq., B.A.

Appointed by the Union Government Department of Forestry (1):

M. van N. Möhr, Esq., B.Sc.

The Director:

Professor H. Shaw, M.Sc.Tech., Ph.D., F.R.I.C.

Honorary Secretary:

P. G. Leeb-du Toit, Esq., B.Com. (*Registrar, University of Natal*).

STAFF

(SEPTEMBER, 1959)

DIRECTOR:

H. Shaw, M.Sc.Tech., Ph.D.(Manc.), F.R.I.C.

Silviculture:

S. P. Sherry, M.A.(Oxon.), B. Sc. (South Africa).
K. Roberts, B.Sc.(Wales).
R. J. F. J. Atkins, B.Sc.For.(Stell.). (*Appointed November*, 1958).

Technical Assistants:

M. J. Lourens.
A. M. MacKenzie.
I. S. Alexander.

Genetics and Plant Breeding:

A. A. Moffett, B.Sc.(Birm.), Ph.D.(Lond.).
Miss K. M. Nixon, M.Sc.(Natal).

Technical Assistant:

B. L. Arbuthnot.

Chemistry:

W. S. Martin, Ph.D., D.Sc.(Lond.), A.R.C.S., D.I.C., A.R.I.C.
C. G. Gordon-Gray, M.Sc.(Natal).

Technical Officer:

R. A. Jones.

Entomology:

L. L. J. Ossowski, M.F., For.Ing., D.Sc.(Poznan).

Technical Officer:

G. B. Wortmann, B.Sc. (Natal).

Biometry:

E. R. Vaughan, B.Sc.Hons.(Natal). (*Died 1st December*, 1958).

Administration:

Miss E. K. Smith.
Mrs. M. J. M. L. Gersbank. (*Appointed April*, 1959).

Non-Europeans:

Eight.

Field Experiment Station Overseer (S.A.W.G.U.):

M. A. Stewart.

FOREWORD

During the year under review, the task of dealing with the large-scale field experiments coming to fruition approached peak level and taxed the Institute's resources of both manpower and equipment to the utmost. At times, only by suspending all other field work and putting everything into harvesting operations was it possible to cope with the situation.

As termination of this first cycle of experiments will, in most cases, spread over several seasons, and as the examination and assimilation of the results will require further time, the full impact of this work on the industry will not be evident for some years. Nevertheless, interim observations and conclusions are being used wherever possible and some significant changes in recommendations have been made. While this is particularly true of silvicultural operations, it applies in some measure to fertilizer recommendations also.

Encouraging progress has been made in two other directions, namely in work on the virus control of bagworm and in the investigation of the genetical background of gummosis. The former so far maintains its promise of offering a practicable means of control, while the latter indicates that the possibility of producing a strain of black wattle resistant to gummosis is by no means a remote one.

The long-awaited start of new experimental work in northern Natal and the Transvaal became possible with the appointment of an additional research officer. On the other hand, the loss of the Institute's Biometrician was a major setback for the work in general. Otherwise, the staff position remains unchanged and still constitutes a limiting factor hindering the full development of the Institute's work.

Recent developments have brought not only increased financial support from the Department of Forestry, but also a closer co-ordination of the work of the Institute with the more general forestry research carried out by the Department. In the case of Entomology, the work will be co-ordinated with forest entomological research for which the Division of Entomology in the Department of Agriculture is responsible.

H. SHAW, *Director.*

October, 1959.

ADMINISTRATIVE REPORT

BUILDINGS AND PLANTATIONS

Main Building.

No work other than routine maintenance has been carried out on the building itself during the past year, but very substantial progress has been made in cleaning up and planting the immediate surroundings of the Institute. All the heavy work of levelling a terrace along the north face and of building a rock garden has been completed and the soil pockets in the rockery are ready for planting up. On top of the bank, a crazy-paved path running the full length of the building has been laid and lawns established on either side. The cost of this and earlier work on the site has been met from University funds.

The general guidance of Professor le Roux, of the Faculty of Agriculture, and the farm labour and equipment made available from time to time by the Field Experiment Station Committee have been invaluable in this work. The ready co-operation of the Superintendent of Grounds and Buildings in the University has made it possible to bring in at the cost only of cartage a large quantity of top-soil to improve this naturally barren and almost soilless area. Through the good offices of Prof. le Roux and the co-operation of the Regional Director of Agriculture, a supply of large boulders sufficient for building the rock bank was made available from the Agricultural Research Institute's farm "Ukulinga". The shale for the path was obtained from the Field Experiment Station "Bloemendal".

Immediately adjacent to this part of the University campus, work was recently started on the new national road which, when completed, will be in close proximity to the Institute.

Field Experiment Station.

In the season 1958-59, 24 acres, the smallest area for several years, were felled, and even of this low total, several acres consisted of sparsely stocked areas of volunteer growth. Over 30 acres were re-established, of which over 9 acres were laid down to experiments, including nearly 5 acres of new genetics experiments. The balance of the new planting is held in reserve against future experimental requirements.

Another demonstration house has been completed by a different method of construction and ground plans and detailed costs of the three houses so far erected have been prepared and are available for distribution. Because of an extensive programme of re-surfacing the farm roads, construction of the projected dam has not yet started.

A formal entrance gateway has been constructed in shale-faced brick, with a tubular metal gate. The style is on simple, but attractive, lines in keeping with the surroundings, and the lay-out is being completed by improvements in the approaches from outside and from the farm.

As part of a widespread investigation on water supplies on which the Geological Survey and the Department of Lands and Water Affairs are working, a geological survey of the farm has been carried out. The resulting geological map will be of great value in planning future experiments.

As only 150 tons of bark and 804 tons of timber were marketed during the year, the total income from produce was over £1,100 less than in 1957-58, with a corresponding increase in the working loss on the farm.

After eight years invaluable service on the Committee of Control, during which period he had not missed a meeting of the Committee, Prof. A. J. W. Bayer went overseas on long leave late in 1958 and was temporarily replaced as a representative of the University Council by Prof. S. F. Bush, a former member of the Committee.

Three ordinary meetings and one special meeting of the Committee were held during the year and Mr. S. Clegg and Major C. J. J. Crowe served as Chairman and Vice-Chairman respectively. Mr H. H. Cornell was again nominated as assessor member of the S.A.W.G.U. Field Experiment Station Committee.

At the close of the meeting held in August, the University Registrar, Mr. P. G. Leeb-duToit, intimated that pressure of other University duties would prevent his continuing as Honorary Secretary to the Committee. Mr. Leeb-du Toit has been associated with the Institute right from the earliest stages of selecting a site and planning the building. He has been Secretary of the Committee from its inception in 1946 and has played a large part in its activities, particularly in shaping a pioneer association with the rest of the University. His tactful guidance and wise counsel in procedure have contributed in no small measure to the very cordial relationship that exists between the Institute and the University Administration.

It had long been evident that the government grant to the Institute had become, as a result of ever increasing costs, quite inadequate to meet even the limited purpose for which the grant was originally established. It is pleasing to record, therefore, that, after representations over a number of years, the grant has now been increased to £10,000 per annum, i.e., doubled. This change is subject to certain conditions which, at the close of the year, were the subject of discussion with the Department of Forestry. The increase, although it barely restores the original real value of the grant, will be a welcome relief in the heavy financial responsibility that falls upon the Wattle Growers' Union.

During the year, revision of research staff salary scales was undertaken and the scales were brought again into line with those of the University teaching staff, behind which they had fallen considerably in recent years. Owing to delay in the revision of C.S.I.R. salary scales and the absence of any suitable alternative established scales, it was possible in the case of the technical and administrative staffs only to effect the consolidation of salaries according to the public service schedule. The salaries of non-European employees were similarly increased during the year.

Expenditure and Income.

The increase of nearly £3,700 in expenditure during the year 1958-59 is almost wholly attributable to the revision of staff salary scales and to normal salary increments, which together accounted for over £3,300, while provision for a provident fund liability required a further £500. Other expenditure remained at about the level of recent years, slightly increased running costs being balanced by lower capital expenditure. With four vehicles in regular use and a replacement necessary in most years, transport costs are inevitably high and, after salaries, constitute much the largest single item of expenditure. Despite the increased cost of salaries, the total expenditure for the year was over £2,000 less than the estimate, a fact in which the Institute finds no cause whatsoever for satisfaction, as it is due entirely to the continued existence of vacancies on the research staff. Fees received for analytical services rendered during the year were more than double those for the previous year.

Although the conditions attaching to the increased government grant had not been formally accepted at the close of the year, the additional grant dating from 1st January, 1959, has been included in the accounts.

The summarized statement of Expenditure and Income for the period 1st September, 1958, to 31st August, 1959, appears below. Detailed Accounts and Balance Sheet are published separately.

RESEARCH INSTITUTE ACCOUNT

1st September, 1958, to 31st August, 1959

Expenditure	£	s.	d.
Research and Administrative Staff, Salaries, etc.	23,139	18	10
Travelling and Subsistence	1,197	3	9
Laboratory and Office Equipment and Maintenance	1,318	15	9
New Vehicle (less trade-in)	1,250	0	0
Library	413	15	11
Printing and Stationery..	284	4	0
General Administration ..	840	2	2
Building Maintenance ..	106	2	9
Special Provident Fund Reserve..	500	0	0
	£29,050	3	2

Income	£	s.	d.
S.A.W.G.U. Grant.. ..	20,563	10	6
Department of Forestry Grant	8,333	6	8
Analytical Services ..	144	18	0
Special Fees	8	8	0
	£29,050	3	2

STAFF

The Institute suffered a severe and tragic loss when, in the early hours of 1st December, 1958, its Biometrician, Mr. Eric Vaughan, died following a level-crossing accident. In some seventeen months as a member of the staff, he had begun to exert a marked influence on the statistical aspects of the Institute's research projects and had shown promise of becoming a most valuable member of the team. Further, in this short time, he had proved himself to be a friendly and most acceptable colleague, and he is greatly missed on personal, as well as professional grounds. Mr. Vaughan's parents have presented his technical books to the Institute Library as a memorial.

In November, 1958, Mr. R. J. F. J. Atkins was appointed Assistant Silviculturist to take charge of experimental and advisory work in the northern wattle areas. He first spent five months at the Institute before proceeding in April to establish headquarters at Piet Retief. None of the other vacancies on the research staff has been filled.

Mr. Sherry was on long leave in the early part of the year, but was frequently in touch with his Section during this period. Mr. B. L. Arbuthnot, a Technical Assistant in the Genetics Section, was granted unpaid leave for the academic session to enable him to complete the final year for a degree in the University of Natal. Mr. G. B. Wortmann, who also had studied for a degree while employed in the Institute, is to be congratulated on being admitted to the B.Sc. degree by the University.

To help keep pace with the increasing amount of office and library work, Mrs. M. J. M. L. Gersbank was appointed Office Assistant in April. Prior to this, Mrs. P. M. Allison had again assisted on a part-time basis during periods of leave and sickness. A Natal University student was employed during the vacations to help with the work in the Entomology Section.

The only application received for the Wattle Research Institute Scholarship for 1959 was withdrawn.

ADVISORY WORK, COMMITTEES, CONFERENCES, ETC.

Advisory.

There was a sharp increase in the number of advisory letters written (316), but this was wholly accounted for by the fact that the number relating to insect pests (237) was almost double the number under this head in recent years. The number relating to Institute publications (25) was again high.

Natal (207) and the Transvaal (78) accounted for all but a few of these letters, but among the 26 places outside the Union from which enquiries were received, South-West Africa and Costa Rica appear for the first time.

There was a considerable increase also in the number of growers' plantations visited, both the Silviculturists (34) and the Entomologists (69) travelling widely for that purpose. The areas of northern Natal, eastern Transvaal, and Swaziland received particular attention, accounting for no less than 65 of the visits paid.

The number of visitors to the Institute remained around the average during recent years of about 80. These included a small group of members of the South African Association for the Advancement of Science on the occasion of the Annual Congress in Pietermaritzburg, and from outside the Union, Dr. M. R. Jacobs, Principal of the Australian Forestry School at Canberra, and Mrs. Jacobs, Messrs. R. Kaye and N. Lewis, also from Australia, Mrs. E. C. Hope, of Canada, Messrs. G. M. McGregor and A. R. Jeffrey, of the Rhodesian Forestry Commission, Mr. W. Osmaston, of the Uganda Forestry Department, and Dr. W. T. H. Williamson, of the Sudan Department of Agriculture.

Tours of private commercial plantations were arranged for several of these visitors, who were also among the 30 or so individuals conducted around the Experiment Station, Bloemendal, during the year. Senior students in the Faculty of Agriculture were given a practical demonstration of wattle growing methods on the farm. The Annual Farmers' Field Day at Bloemendal, on 12th March, was one of the most successful ever to be held there. Nearly 100 visitors were present, on a very fine day, and lively questioning and discussion were evidence of the interest taken in the various demonstrations. A surprisingly large number stayed on in the afternoon to inspect the new houses for the farm labour. Ground plans and detailed costs of the houses were available and there was a keen and very useful discussion on the subject.

The Institute has again furnished advice and information to a number of public authorities, among them the Union Government Departments of Agriculture and Forestry, the Natal Provincial Education Department, the Food and Agriculture Organization of the United Nations, the Commonwealth Institute of Biological Control, the Northern Rhodesia Forestry Department, the Southern Rhodesia Division of Irrigation, the United States Embassy, and several central reference libraries, both in the Union and overseas. Commercial and industrial enquiries have also been dealt with.

There was a marked increase in the number of samples of commercial wattle bark submitted by the Government Bark Inspector for analysis. This arose largely from the renewed emphasis on quality and correct grading in the industry.

The Entomology Section again organized the annual bagworm survey and made the consequent inspections and recommendations for commercial spraying. The treatment of over 3,000 acres was supervised and the results assessed. An advisory article entitled "Measures against Bagworm", by Dr. L. L. J. Ossowski, was published in the *Farmer's Weekly* of 17th June, 1959.

Two other general articles were published in the farming press, namely "The Future of Wattle Bark—Quantity or Quality", by Mr. S. P. Sherry, in the *Farmer's Weekly* of 4th February, 1959, and "The Chemical Control of Bramble", by Dr. H. Shaw, in *NAUNLU* of 15th May, 1959. Mr. Sherry also wrote an article entitled "Making Farm Waste Land Pay" for the *Natal Witness Royal Agricultural Show Supplement*, 24th June, 1959. Details of the Institute's scientific publications during the

year are given on page 51 of this Report. These latter are fewer than in recent years, but five others have been accepted for publication and several have been delayed in printing.

At the request of the Interafrican Bureau for Soils and Rural Economy, Mr. Sherry prepared a report on "Experimental Measurement of Run-off and Soil Erosion in Wattle Plantations in Natal" for presentation at the Third Interafrican Soils Conference to be held in November.

The Institute organized the Wattle Industry exhibit at the Royal Agricultural Society's 1959 Show in Pietermaritzburg. The themes were quality production of wattle bark and the virtues of genuine leather.

The Institute's Library facilities have again been freely used by members of the University staff and students, while help has been given by way of information and discussion to others engaged on research projects. Literature and wattle specimens have been supplied to a number of schools.

Committees, etc.

The Director attended a Meeting of the Research Advisory Council of the Paint Industries Research Institute, Durban, in February and the Annual Meeting of the Institute in May. He also attended the Annual Meeting of the Research Advisory Council of the Leather Industries Research Institute at Grahamstown in June. A meeting of the Wattle Technical Committee was held on the preceding day and another meeting of this Committee was held in Pietermaritzburg in November, when Dr. Martin and Mr. Gordon-Gray also were present.

The Director attended all the meetings of the General Committee of the Wattle Growers' Union, the final meeting of the Wattle Industry Special Joint Committee, and, accompanied by Mr. Sherry, a meeting of the new Wattle Industry Advisory Committee. He also attended, as Chairman, the one meeting of the Wattle Timber Research Fellowship Steering Committee held during the year.

The Director and Mr. Sherry again served on the Wattle Growers' Union Field Experiment Station Committee and the Royal Show Sub-committee. They also attended by invitation a meeting of the Richmond Soil Conservation Committee to give technical advice on the control of bramble and on related matters involving the burning of brushwood. Mr. Sherry again took a leading part in the work of the Fire Legislation Sub-Committee and also attended a meeting of the Wattle Industry Joint Quota Committee. The Director and Dr. Ossowski continued their active membership of the Pest Control Sub-Committee. They were also appointed to the Co-ordinating Committee for entomological research in the wattle industry recently set up by the Department of Agriculture. As Chairman of the Sub-Section of Insect Viruses at the forthcoming International Congress of Entomology in Vienna, Dr. Ossowski has been responsible for organizing the scientific proceedings on this topic. This work has already led to many valuable contacts throughout the world.

Conferences, Lectures, Meetings, etc.

For a variety of reasons, members of the Institute staff have addressed more meetings during the year than has been usual in the past. This is due largely to technical problems arising out of the current developments in the industry and to the increasing interest of growers in the issues involved. Mr. Sherry addressed meetings of growers at Goedgegun, Kambula, Lenjane, Paulpietersburg, Piet Retief, and Scheepersnek, while Dr. Ossowski addressed a meeting at Vryheid. Both, together with members of their sectional staffs, took part in a Field Day arranged by the Harding Farmers' Association.

The Institute has maintained close liaison with the South African Timber Growers' Association and has taken part in several of the Field Days organized by that body.

The Director presented a paper on the chemical control of bramble to a Weeds Conference organized by the Natal Region of the Department of Agriculture.

During the year, the Institute "took to the air" for the first time, taking part in no less than four broadcasts by the S.A.B.C., one of which was repeated. One complete edition of "Calling All Farmers" was devoted to the work of the Institute. The Director and all the Heads of Sections took part and the recording was broadcast on 12th March and again on 25th June, 1959. The Director contributed to a symposium on "Forests and Future" broadcast on 23rd June, 1959, while Mr. Sherry used similar material for a talk in Afrikaans in the programme "Die Soeklig" from Durban on 2nd July, 1959. The Director and Mr. Sherry took part in a broadcast from the Royal Agricultural Show describing the nature and purpose of the Wattle Industry's exhibit.

LIBRARY

The 38 books added to the Library by purchase and donation constituted the largest annual accession since the initial purchases in 1948. In addition, 29 volumes were received as a memorial gift from the estate of the late Mr. E. R. Vaughan, for which gift the Institute is deeply grateful to Mr. and Mrs. A. Vaughan. An accession of 43 bound volumes of periodicals brings the total of books and periodicals to 371 and 409 respectively. Including 328 received during the year, the total number of bulletins, reprints, etc. is now 2,768.

Thanks are due to The Natal Tanning Extract Co., Ltd., for the gift of a copy of the Report of the 11th Congress, Rome, 1953, of the International Union of Forest Research Organizations, to the Union Minière du Haut Katanga for a copy of their Jubilee publication, and to Messrs. Potash S.A. (Pty.) Ltd., for the new French periodical "Fertilité".

ACKNOWLEDGEMENTS

The Institute gratefully acknowledges its indebtedness to the undermentioned.

To the Entomologists of the Commonwealth Institute of Entomology and of the British Museum (Natural History) for assistance in identifying entomological material.

To the Division of Entomology in the Australian Commonwealth Scientific and Industrial Research Organization for information on wattle insects in Australia.

To Professor J. C. le Roux for further guidance and active help in building up and laying out the Institute surroundings.

To the Comec Mimosa Extract Co., Ltd., for co-operation in sampling and handling substantial quantities of bark from experimental plots.

To the Transvaal Wattle Growers Co-operative Agricultural Co., Ltd., for the provision of office accommodation in Piet Retief for the research worker located in the northern areas.

To all growers who have placed portions of their plantations at the disposal of the Institute for experiments, and to those who have sent material for the Institute's insect collection.

REVIEW OF WORK IN PROGRESS

(a) SILVICULTURE

1. Thinning Experiments.

(*a*) Experiment S.3 at Bloemendal (Pietermaritzburg district), designed to determine the optimum final density for different lengths of rotation, was re-measured in January, 1959. Comparison of the mean breast height diameters of a fixed number of dominants in each treatment showed that at eight years of age on this site, plots at densities of 550 and more trees per acre were significantly suppressed ($P = 0{\cdot}05$) in relation to plots at densities of 500 or fewer per acre.

(*b*) Experiment S.34 at Bloemendal, similar in objective to S.3, was re-measured in December, 1958, at three years of age. No differences could be detected in the degree of suppression between plots over the range of densities which are being compared in this experiment, viz. 300 to 700 trees per acre.

2. Thinning and Weeding in Relation to Disease Incidence.

Experiment S.2 at the Umvoti Wattle Company Estate (Kranskop district) was laid out in November, 1949, to compare the effect upon yield and disease incidence of different rates of thinning and different methods of weeding.

The thinning treatments applied were as follows:

Treatment	Number per acre remaining after thinning at mean heights shown							Number of operations
	6 in.	3 ft.	5 ft.	10 ft.	15 ft.	25 ft.	35 ft.	
A	1210	540					500	3
B	2420		1210		730		500	4
C	4840	2420	1210	810	610	540	500	7
D	9680	4840		2420	1210	610	500	6

These thinning treatments occupied sub-plots in a split-plot design in which main plots received one of the following weeding treatments, after a preliminary clean hoeing when the seedlings were about six inches high:

(i) No weeding; wattle regrowth removed by hand-pulling while very small.

(ii) Weeds and wattle regrowth removed by hand-pulling.

(iii) Weeds and wattle regrowth removed by hoeing.

Weeding was carried out four times, i.e. when the trees were two, six, eleven, and fifteen months old.

Observations made when the trees were three years old (*Report for 1952-1953*) showed that there was a significantly higher ($P=0{\cdot}01$) percentage of trees suffering from gummosis in plots which were weeded than in those which were not. There was, however, no significant difference in gummosis incidence between hoed and hand-weeded plots nor between any of the four thinning treatments.

When the trees were four years and nine months old (*Report for 1953-1954*), differences between weeded and unweeded plots were still present although the numbers of trees showing gummosis symptoms were much reduced as a result of healing having

taken place. Affected trees at this stage were mainly those which had become infected by wood-rotting fungi through gummosis lesions or wounds caused in hoeing, and hoed plots were found to have significantly more ($P = 0{\cdot}05$) gummosis than hand-weeded plots. Differences due to thinning were also apparent, plots which had received the A and C thinning treatments having significantly more ($P = 0{\cdot}01$) gummosis than those which had received the B and D treatments.

The experiment was harvested in January, 1959, at nine years of age and gave the following results:

Mean d.b.h. in inches

Weeding treatment	Thinning treatment				Mean
	A	B	C	D	
No weeding	6·02	6·07	6·28	5·78	6·04
Weeding by hand-pulling..	6·25	5·97	6·25	5·82	6·07
Weeding by hoeing	5·80	5·97	6·00	5·87	5·91
Mean	6·02	6·00	6·18	5·82	

	Weeding	*Thinning*	*Interaction*
Standard error	0·049	0·068	0·144
Significant difference ($P = 0{\cdot}05$) ..	0·15	0·21	0·45
Significant difference ($P = 0{\cdot}01$) ..	0·22	0·30	0·65

Mean dry bark yield in long tons per acre

Weeding treatment	Thinning treatment				Mean
	A	B	C	D	
No weeding	4·97	5·17	5·34	4·53	5·00
Weeding by hand-pulling..	5·19	4·72	5·10	4·65	4·91
Weeding by hoeing	4·64	4·90	4·89	4·68	4·78
Mean	4·93	4·93	5·11	4·62	

	Weeding	*Thinning*	*Interaction*
Standard error	0·097	0·097	0·205
Significant difference ($P = 0{\cdot}05$) ..	0·31	0·31	0·65
Significant difference ($P = 0{\cdot}01$) ..	0·43	0·43	0·92

Mean tannin yield in long tons per acre

Weeding treatment	Thinning treatment				Mean
	A	B	C	D	
No weeding	1·88	1·91	1·97	1·67	1·86
Weeding by hand-pulling..	1·90	1·71	1·89	1·72	1·80
Weeding by hoeing	1·73	1·83	1·81	1·73	1·78
Mean	1·84	1·82	1·89	1·71	

	Weeding	*Thinning*	*Interaction*
Standard error	0·040	0·040	0·084
Significant difference ($P = 0{\cdot}05$) ..	0·13	0·13	0·27
Significant difference ($P = 0{\cdot}01$) ..	0·18	0·18	0·38

Plots weeded by hoeing had a significantly smaller ($P = 0{\cdot}05$) breast height diameter than those weeded by hand-pulling, but weeding treatment apparently had no significant effect upon the yield per acre of dry bark or tannin, and plots weeded only once were not significantly inferior in rate of growth to those weeded four times.

There was no significant difference in breast height diameters or yields of dry bark and tannin between plots in the A, B, and C thinning treatments, but those in the D treatment had a significantly smaller ($P = 0{\cdot}01$) diameter than those in the C treatment, and their yields of dry bark were significantly lower than those from any other treatment. Tannin yields from the C and A treatments were significantly higher than those from the D treatment at the 0·01 and 0·05 levels respectively, while the difference between those of the B and D treatments just failed to achieve significance.

It would appear that frequent weeding may be a direct cause of gummosis, even though actual root injury is kept to a minimum by hand-pulling of weeds and regrowth. The fact that hoed plots had significantly more gummosis than hand-weeded plots suggests that hoeing injury to the larger lateral roots may have been a contributory cause. It seems likely also that mechanical injury to the root system may have been the cause of the significant difference in mean diameter between hoed and hand-weeded plots at harvesting.

Whether these ideas are correct or not, the important fact emerges that the bark and tannin yield of plots in which weeding was confined to a single operation when the seedlings were about two months old did not differ significantly from that obtained from plots which were weeded four times. It would seem, therefore, that a considerable saving in weeding costs may be effected, without detriment to the final bark yield and with every likelihood of reducing the incidence of gummosis, merely by reducing the number of hoeing operations to one or, at most, two. As a result of observations in this experiment, control of weeds by hoeing during the early life of re-established stands at Bloemendal Field Experiment Station was reduced some four years ago to a single operation. In cases where vigorous regrowth of weeds necessitated additional control measures, these were carried out by slashing or mowing rather than by any method involving soil disturbance. In the absence of proper controls, direct comparisons are not possible, but the incidence of gummosis in stands so treated appears to be considerably lower than was the case in stands regenerated in previous years, which received from two to four clean hoeings during their first two growing seasons.

Whereas both the B and D thinning treatments showed a low incidence of gummosis, the former produced a significantly higher bark yield than the latter and, therefore, is to be preferred. A modification of this thinning regime, which has been introduced at Bloemendal and is giving satisfactory results, is as follows:

Dominant height of stand*	Number per acre	Average distance apart, after thinning, in			
		6′ rows	9′ rows	10′ rows	12′ rows
9 inches	2420	3 feet	2 feet	2 feet	1½ feet
6 feet..	1210	6 feet	4 feet	4 feet	3 feet
12 feet..	700	10 feet	7 feet	6 feet	5 feet
20 feet..	±500	14 feet	10 feet	9 feet	7 feet

*Average height of the tallest 20 per cent. of the stand.

3. Studies in Frost Behaviour.

(*a*) Experiment S.N.2 was laid down at Vroegeveld (Piet Retief district) in June, 1959, to study air temperature behaviour in winter at different levels above ground and over different surfaces as a preliminary to the investigation of methods of protecting wattle regeneration against frost.

The site chosen for the experiment was near the edge of a newly felled wattle plantation on a south-westerly aspect with a slope of 2° 20′ to the west and 1° 20′ to the south. Outside the plantation, an area of natural grassland sloped down to a stream

about 400 yards away. The experimental area was sheltered on the northern side by a wattle plantation about 100 yards away, and there was a small group of eucalypts and wattles about 50 yards to the south, but to the west there was open grassland, and to the east, the nearest trees were at least 600 yards away.

The design of the experiment was a latin square, with plots eleven yards square (0·025 acre), and the treatments were as follows:

A. Surface covered with grass.
B. Surface covered with dry, wattle leaf litter.
C. Bare soil surface broken up to simulate the effect of disc-cultivation.
D. Bare unbroken soil presenting a fairly smooth, hard surface.

The natural grass cover on the plots in treatment A was found to vary from about 17 to about 99 per cent. Grass tufts were dug up in the vicinity, therefore, and planted on the plots to give a uniformly complete cover in all cases. Where the litter layer in plots in treatment B was sparse or absent, litter was collected from elsewhere in the plantation and spread to give a uniformly covered surface in all plots.

A maximum and minimum thermometer was mounted at a height of 45 cm. above the ground on a post in the centre of each plot, and daily minimum temperature readings were taken for a period of 75 days from 14th June, 1959. At the beginning of July, a second maximum and minimum thermometer was installed in each plot at a height of 2·5 cm., and daily minima were recorded at this level for a period of 58 days. In an attempt to determine whether lateral mixing of air from adjacent plots was likely to introduce an error, hessian screens, three feet in height and enclosing an area nine feet square, were erected on one row of plots towards the end of the experimental period, and minimum temperatures at both levels within these screens were compared with those from unscreened plots over a period of 27 days. Although no differences in temperature trends between screened and unscreened plots were observed over this period, it is possible that the screens were not high enough to prevent some lateral mixing of air.

The results of the main temperature study were as follows:

Nature of surface	Minimum daily temperature (°F.)			
	2·5 cm. above ground		45 cm. above ground	
	Mean	Lowest	Mean	Lowest
A. Grass	28·6	19·0	33·9	27·0
B. Wattle leaf litter	30·3	21·5	33·9	27·0
C. Bare cultivated soil ..	31·9	23·0	34·4	27·5
D. Bare unbroken soil ..	33·6	25·0	34·6	28·5
Standard error	0·41		0·12	
Significant difference (P = 0·05)	1·4		0·4	
Significant difference (P = 0·01)	2·1		0·6	

In accordance with expectation, based on similar studies carried out in Europe and reported by Geiger (1950), mean minimum temperatures were lowest over grass and leaf litter, followed by those over cultivated soil and unbroken soil in that order. This trend was observed at both levels, though the range was greater at 2·5 than at 45 cm.

There was no indication of a temperature inversion at 45 cm. above ground, the temperatures at 2·5 cm. being invariably lower than those at 45 cm. over all types of surface. This is contrary to the results reported by Beard (1957), but because of the small size of the plots in the present experiment, lateral movement of air may have obscured temperature inversion. It is proposed, therefore, to repeat the experiment next winter using plots 0.1 acre in area, or four times as large as those used this year, in order to reduce the effect of air movement from adjacent surfaces with different types of cover.

The temperature over grass was significantly lower than that over leaf litter at the 2·5 cm. level, but temperatures over these two surfaces did not differ at the 45 cm. level. At both levels, however, temperatures over grass and litter were significantly lower than those over bare soil. The small temperature gradient with increasing height above ground and the relatively high minimum temperatures over bare soil as compared with those over grass- or litter-covered soil indicate that the removal of all surface cover from beneath and around wattle seedlings is likely to reduce injury by frost. Moreover, as air temperatures at 2·5 cm. were significantly lower over loose cultivated soil than over unbroken soil, some means of compacting the soil after cultivation may have to be sought in order to secure the maximum benefit of heat radiation as a protection against frost. Grass- or litter-covered soils must be disc-harrowed before winter to bury the organic matter, and rolling this cultivated surface would probably be the most practical means of securing the necessary consolidation. If rolling proves impracticable, however, it will be necessary to carry out disc-harrowing well before the first frosts are likely to occur and so to allow the soil surface to become compacted naturally.

4. Wattle Shelterwood Experiments.

It was not possible to determine the efficacy of dead trees as a shelterwood in Experiment S.36 at Moorburg (Estcourt district), since the nurse trees were not stripped standing during the summer of 1958-59 as had been intended. Dense seedling regeneration appeared during that summer, and in May, 1959, three height classes were represented in the regenerated stand. Seedlings over six feet in height were the survivors of the November, 1957, sowing, those three to six feet were the survivors of natural regeneration which appeared during the summer of 1957-58, and the remainder, less than one foot high, were the natural regeneration of the 1958-59 summer. These small seedlings occurred mainly between the originally sown lines and were pulled out in August, 1959. Immediately after this cleaning, the survival of seedlings in the remaining height classes, on the basis of a minimum average spacing of two feet apart in nine foot rows, was as follows:

Treatment	Number of seedlings surviving per acre		
	3–6 feet	Over 6 feet	Total
60 nurse trees per acre ..	1260	450	1710
80 nurse trees per acre ..	760	540	1300
100 nurse trees per acre ..	1110	510	1620
150 nurse trees per acre ..	1020	460	1480

The total numbers of seedlings surviving under different densities of shelterwood were very similar and were adequate in all cases to provide a fully stocked stand. The similarity in numbers of survivors under a fairly wide range of shelterwood densities is probably attributable to greater mortality due to frost under the lower densities of cover being offset by greater mortality resulting from root competition with the shelterwood trees under the higher densities. It would seem, however, that the retention of a well-distributed shelterwood of about 100 trees per acre, when felling plantations in areas where frost damage may be expected, will provide sufficient cover to protect the resulting regeneration from serious frost damage. If the shelterwood trees can be stripped standing after the first winter, root competition will be obviated and it is thought that the barrier to free radiation presented by the dead trees will prove sufficient to protect the seedlings against frost damage until they are tall enough to be out of danger.

5. Use of Wattle in Arable Crop Rotations.

The treatments in Experiment S.40 at Bloemendal (*Report for 1957-1958*) were repeated on the same plots during the 1958-59 season. The harvesting of the maize silage crop (Treatment C) was not delayed as in the previous season, but was carried out in January as prescribed, and the swedes were sown as soon as the ground could be re-prepared. The seed, however, germinated very irregularly and the resulting crop was distinctly poor, though not a complete failure as in the previous season.

As a result of the revised views of local agronomists on the values placed on the various crops in the above *Report*, the results for the two seasons have been re-calculated using values of £15, £6, £2, and £2 per short ton (2,000 lb.) for maize grain, *Eragrostis* hay, maize silage, and swedes respectively. In all cases, the cost of fertilizer has been deducted from the cash value of the crop.

The results are as follows:

Treatment	Yield lb./acre		Equivalent/acre		Estimated nett value £/acre	
	1957-58	1958-59	1957-58	1958-59	1957-58	1958-59
A. Maize for grain ..	2298·5	2709·0	11·49 bags	13·55 bags	13·696	16·775
B. Maize for grain ..	2070·5	1840·0	10·35 bags	9·20 bags	13·659	11·930
C. Maize for silage ..	27323·0	23515·0	13·66 tons	11·76 tons	20·237	19·973
C. Swedes	—	4180·0	—	2·09 tons	—	0·637
D. *Eragrostis* for hay..	689·3	11494·0	0·34 tons	5·75 tons	–0·442	32·147
Standard error					0·173	1·240
Significant difference (P = 0·05)					0·599	4·291
Significant difference (P = 0·01)					0·907	6·499

In the 1957-58 season, the difference in grain yield between treatments A and B was counterbalanced in terms of value by the cost of potash applied in the former treatment only, and there was consequently no significant difference between the nett crop values of these treatments. In the 1958-59 season, the A treatment outyielded the B treatment by more than four bags per acre, and the difference in net crop values between these treatments was significant (P = 0·05).

The cash value of the maize silage in the first season had to be reduced by the cost of the fertilizer used on the unsuccessful swede crop. Despite this, the return from the C treatment was significantly higher (P = 0·01) than that from either the A or B treatment. In the second season, however, there was no significant difference between the combined return from maize silage and swedes and that from maize grain in the A treatment, which received a similar fertilizer dressing, but the return from the former treatment was still significantly higher (P = 0·01) than that from the B treatment, which received no potash.

The fact that the yield of maize silage was lower in the second season than in the first was probably due more to the fact that the maize was allowed to grow several weeks longer in the first season than to depletion of the nitrogen content of the soil. The poor return from swedes over the two seasons suggests that it would probably be more profitable to allow the silage crop to stand to the end of February before harvesting and to abandon attempts to obtain a crop of winter roots in addition.

The hay crop in the first season was extremely poor and actually showed a loss of about 8/6d. per acre, but in the second season, the cash return from hay was significantly higher (P = 0·01) than that from any of the other crops grown. Provided that yields do not fall off considerably as the nitrogen stored in the soil by the preceding wattle crop becomes depleted, *Eragrostis curvula* hay may prove to be a more profitable means of utilizing this stored nitrogen than any arable crop. Furthermore, annual weeds present a serious problem in the establishment of wattle on land which has been under arable crops for more than a year or two, but it is unlikely that there will be any con-

siderable weed problem when *Eragrostis* pasture is ploughed up for the establishment of wattle. For this reason also, a ley crop would be preferable to one involving annual ploughing.

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(b) GENETICS AND PLANT BREEDING

1. Interspecific Hybrids.

(*a*) *Black wattle* (Acacia mollissima) x *green wattle* (A. decurrens). When interspecific crosses are made between species of tan wattles, the seedling leaves of the hybrids almost invariably show a greater or lesser degree of chlorosis. In later generations, segregation for normal and chlorotic seedlings occurs, while the F_2 families and the back-crosses to green wattle produce a high frequency of chimaeras of normal green and chlorotic tissues (*Report for 1952-1953*). Such a sorting out of plastids as occurs in these chimaeras suggests that some form of gene-cytoplasmic interaction may be operating.

Because of the shorter time taken for green wattle to mature seed, the original crosses between green and black wattles were made using green as seed parent. All back-crosses were made with the F_1 hybrid as seed parent, partly because of the higher degree of pollen sterility in the hybrids compared with the parents and partly to take advantage, when back-crossing to black wattle, of the shorter ripening period for seed, which was known to be dominant in the hybrid (*Report for 1954-1955*). All families studied so far have, therefore, had green wattle cytoplasm.

In 1952, the reciprocal crosses were made, black wattle being used as seed parent, and a number of hybrids, all showing some degree of chlorosis in the seedling stage, were produced. These hybrids started to flower freely from July, 1959, and in flowering time, flower colour, and other morphological characters, they closely resembled the opposite cross. During the season, a fairly large scale attempt was made to obtain F_2s and back-crosses of the black x green hybrids to both parents to test whether there is any difference in seedling behaviour according to whether the hybrids have black or green wattle cytoplasm. At the time of reporting, the breeding programme has not been completed and success in terms of seed yield has still to be determined.

(*b*) *Seed-maturing period of hybrids.* Green wattle seed ripens 4-5 months after flowering, whereas black wattle takes about 14 months to do so. If the shorter time of ripening, which is dominant, could be incorporated into black wattle, it would be of considerable advantage from a breeding point of view.

Families of second back-crosses of green x black wattle hybrids to black wattle were scored at intervals for seed ripening. In some families, a number of the trees, which now resemble black wattle very closely, matures seed in the shorter period as with green wattle. In other families, it has proved extremely difficult to decide whether seed maturation is of the shorter or longer type. This difficulty arises from the late and erratic flowering during the previous season, coupled with the fact that the back-crossed families flower several months later than green wattle and seed ripening is slowed down by colder weather. It has not been possible to determine the segregation of the shorter and longer ripening period with any high degree of certainty.

(*c*) *Black wattle* x Acacia baileyana. The majority of trees in the presumed F_2 from this hybrid (*Report for 1955-1956*) have died, but of those remaining, a few are of sufficiently good form and vigour to warrant further work.

2. Inbred Lines.

With increasing age, the differences between S_1 families and the uniformity within families are becoming more and more obvious. From these differences, it is now evident that many morphological characters, such as straight or wavy stem, number and angle of branches, and forking and dimpling of the stem below each lateral branch, are largely genetically controlled. Possibly more important from the economic point of view are the striking differences between selfed families in the incidence and type of gummosis. To assess this, the trees were divided into six categories, namely no gummosis, healed lesions, slight gumming, moderate gumming, severe gumming, and death due to gummosis. The incidence of gummosis in eleven S_1 families is summarized in the table below.

Incidence and degree of gummosis in S_1 families

Family	Number of trees	Incidence of gummosis					
		No gummosis	Healed lesions	Slight gumming	Moderate gumming	Severe gumming	Died from gummosis
S1/55	63	54	2	1	3	3	—
S2/55	17	11	—	—	2	4	—
S3/55	24	11	—	2	6	5	—
S4/55	22	12	—	—	2	8	—
S5/55	24	12	—	4	8	—	—
S6/55	26	22	—	3	1	—	—
S7/55	22	21	—	—	—	1	—
S8/55	26	15	—	2	3	6	—
S9/55	20	16	1	1	2	—	—
S7/54	36	5	1	5	5	12	8
S9/54	40	34	—	2	2	2	—

Differences between families were highly significant. S1/55, S7/55, and S9/54 had a significantly lower ($P = 0{\cdot}05$) than average incidence of gummosis, whereas S7/54 had a significantly higher ($P = <0{\cdot}01$) incidence. In S7/54, the effect of gummosis was particularly severe. Although less than five years old, over 22 per cent. of the trees had already died of the disease, while several of those recorded as "severe gumming" showed signs of dying.

Not only did the families differ in the number of infected trees, but differences in the type of gummosis also occurred. In commercial plantations, two types have been noted, viz. one in which gum exudes in large quantities from a comparatively small number of fairly large cracks in the bark, and a less common type in which there is a large number of small, round lesions, each exuding a small amount of gum. This type is referred to as "speckled gummosis". In eight out of nine 1955 S_1 families, gummosis was of the common type, but in the ninth, S5/55, 12 trees were infected out of a total of 24 and of these, 9 were of the speckled type and 3 doubtful speckled. Trees with this type of gummosis did not occur in the other eight families. It would seem, therefore, that the speckled type of gummosis is a manifestation of the disease on trees of a particular genetic constitution.

The marked differences in susceptibility to gummosis noted in selfed families holds out considerable promise for the selection of resistant strains.

3. Progeny Testing and New Accessions.

(*a*) *Eighth trial* (*planted 1958*). A trial comparing 49 families arranged in a 7 x 7 lattice square was planted during December, 1958. Of these families, 25 were from open-pollinated seed from trees selected for high tannin and for freedom from gummosis. Families from three parent trees having severe gummosis were also included so that some comparison could be made of the incidence of gummosis in the progeny from infected and non-infected trees; a family from commercial seed was included as a general standard.

The remaining 20 families were from seed collected by Mr. S. P. Sherry during his tour of Australia in 1957. These new accessions come from widely differing areas covering practically the whole geographical and climatic range of black wattle in Australia and they should provide a valuable source of breeding material.

A routine height measurement made in July, 1959, when the mean was only 2·1 feet, showed significant differences between families, but no detailed scoring was carried out at this stage.

(*b*) *Seventh trial* (*planted 1957*). In this trial also, there are 49 families in a lattice square. Unfortunately, the stand is uneven and growth very variable and it was difficult to make any comparative assessment of the families. Detailed scoring has been left over, therefore, until differences in growth between trees have levelled up to some extent. A height measurement was made in July, 1959, when the mean was 11·3 feet, but differences between families just failed to reach the level of significance, possibly owing to the high statistical error of the experiment.

(*c*) *Fifth trial* (*planted 1955*). This trial was scored in some detail for branching characteristics and a statistical analysis of the differences made. Five distinct types of branching which seemed worth recording were noted. These were forking of the stem below breast height, forking towards the top of the tree, angle of the lateral branches to the main stem, quantity of lateral branches, and type of laterals. Significant differences between families for the number of forked trees have been reported previously (*Report for 1957-1958*). Since measurements of the other three branching characters would have been too time consuming, three categories were made for each character and the allocation of each tree decided by eye. Angle of branches was recorded as acute, acute to right-angled, or right-angled. The quantity of branches was estimated as numerous, moderate, or sparse and the type as heavy, medium, or light, depending upon whether the laterals were long and thick, of average length and thickness, or short and thin.

Statistical analysis based on these categories showed that there were highly significant differences ($P = <0{\cdot}01$) between families for all three branching characters. There was also a strong association between the number and the heaviness of the branches; trees with numerous branches were more likely to have long, thick laterals than trees with few. This association agreed very closely with that reported previously in the 4th progeny trial (*Report for 1957-1958*). These findings were supported also by observations on inbred families mentioned above.

It would seem, therefore, that branching habit is genetically controlled to a considerable degree and it is expected that it will be possible to select strains of the different branching types. Some of these would be an improvement from a commercial point of view, but it still remains to determine whether there is any association, detrimental or otherwise, between branching characteristics and other characters of importance such as bark thickness, tannin content, or susceptibility to gummosis.

A detailed study of the incidence of gummosis and black butt was made during February, 1959. There were significant differences ($P = 0{\cdot}01$) between families for the incidence of both gummosis and black butt and there was a strong correlation between the two. It is generally assumed that black butt is frequently due to wood-rotting fungi invading the tree through gummosis lesions.

As there were clear differences between families in the incidence of gummosis, the parent trees were again examined to see whether there were any indications of a parent-progeny correlation for susceptibility. The parents had been scored for gummosis in 1957 and a completely independent scoring was made in August, 1959. On the basis of a combination of these examinations, each parent tree was assigned a degree of gummosis ranging from 1 (complete freedom from the disease) to 6 (a severe infection). Gummosis in the progeny was recorded as four degrees of infection and the total amount per family expressed as a percentage of the mean of the whole experiment. A test between the degree of infection in the parent tree and the percentage infection in its

progeny gave a correlation coefficient of 0·3405 with 47 d.f., which is significant between the 0·02 and 0·01 levels.

While this result on its own may not be conclusive, when it is taken in conjunction with the differences between inbred families mentioned above, there can be little doubt that there is a high degree of genetic control of susceptibility to gummosis. The above correlation was between the parent tree and its open-pollinated progeny; controlled pollinations between trees selected for resistance to the disease should show an even closer relationship. A number of such crosses was made during November, 1958, but ripe seed cannot be expected until January or February, 1960.

(*d*) *Selections of trees for progeny testing.* Sixty-six 4-year old trees were selected in families originating from trees selected in 1952. Samples of bark were taken at quarter height from each tree to obtain an estimate of tannin content and bark thickness. The tannin content ranged from 30 to 45 per cent. between trees, and bark thickness from 3·7 to 6·8 mm. There was no correlation between tannin content and bark thickness or diameter, but bark thickness and quarter-height diameter were fairly closely related ($r = 0{\cdot}6458$, 63 d.f.).

It was noted that the wounds left by the removal of bark samples showed considerable differences in the amount of gumming from the cut surfaces. These differences suggested that artificial wounding might give an additional criterion for testing susceptibility of trees to gummosis. Selected trees were, therefore, scored for gumming from the sample wound and gumming elsewhere on the trunk. When there was no gumming from the wound, a significantly higher proportion ($P = <0{\cdot}02$) of the trees than random expectation had no gum elsewhere. On the other hand, when there was gumming from the wounds, there were more trees with gummosis elsewhere than trees free from it, but the difference did not reach the level of significance.

4. Vegetative Propagation.

Further attempts to propagate wattle by grafting, budding, or cuttings were unsuccessful. Thanks, however, to an arrangement made by Dr. H. Shaw while on leave in 1958, Mr. R. J. Garner and Dr. A. B. Beakbane, of East Malling Research Station, Kent, have very kindly offered to help with this problem. Seeds of black wattle have been sent to Mr. Garner so that he can grow young trees and try out various grafting methods on them, and young stems have been sent to Dr. Beakbane for histological examination to try to determine where the difficulty in these methods of propagation lies. The opinions of these experienced workers on vegetative propagation should do much to decide whether there are, in fact, practicable methods of propagating wattle vegetatively other than by air-layers.

Propagation by means of air-layers was continued on an increased scale. Many air-layers which died without forming roots were examined for possible causes of failure, and two possible reasons were noted. First, temperatures inside the air-layers may be too high during hot weather. When the air temperature was 84°F., the temperatures inside three air-layers were between 96° and 97°F., while on the following day, with an air temperature of 85°F., the temperature inside a layer was 106°F. Covering with a layer of aluminium foil reduced the temperature to 89°F. As considerably hotter days occur, it is possible that temperatures inside the air-layers may sometimes reach a lethal level, although many layers exposed to full sunshine rooted freely. Secondly, when layers which had failed to form roots were opened, it was found that there was a deep groove in the bark where the string had been tied and the bark between the ring-barked area and the upper tie was dead and corky. It is possible that when the string is tied very tightly, the bark and cambium below it are killed. Both these possible causes of failure are being followed up.

5. Pollination Mechanism.

As no clear conclusions have yet been reached as to the amount of wind-pollination occurring in wattle, further work was carried out to test the effect of isolating inflorescences from large insects, particularly bees, but not from wind-carried pollen. The

immediate aim was to devise a suitable type of bee-proof cage preparatory to carrying out a more detailed test during the next flowering season. A framework constructed of aluminium wire (2·2 mm. diameter, approximately 13 S.W.G.) and covered with nylon gauze with a mesh of 2·7 x 2·3 mm. proved satisfactory. The extent to which the nylon gauze prevented free passage of pollinia was first tested. Three cages were set about four feet above ground level at the edge of a green wattle plantation in full flower. In each cage, four microscope slides coated with glycerine jelly were placed to trap pollen, and three similar sets of slides were placed at the same level outside the cages but close to them. Sets of slides were exposed for periods of 2, 4, and 5 days respectively. For counting, a $\frac{3}{4}$-inch square cover glass was placed on the slide and all pollen in the area covered by it counted. Taking all exposure times together, that is 11 days in all, the total number of pollinia caught on the slides was 369 inside the cage and 705 outside. The nylon gauze evidently hinders free circulation of pollinia, but probably not sufficiently to prevent cross-pollination if wind-borne pollen is an important factor.

During October, 1958, cages were put on four inflorescences on each of two trees, one black wattle and the other *A. irrorata*. Both these trees are known to set seed freely with open-pollination. Near each cage, a comparable inflorescence was left for open-pollination. In addition, several inflorescences on each tree were covered, with Cellophane bags. At the time of writing, seed has not yet ripened, but pod counts have been made and the numbers occurring following different treatments are given in the table below:

Pods formed following open-pollination, caging, and bagging

	A. mollissima			*A. irrorata*		
	No. of inflor-escences	No. of pods	Mean	No. of inflor-escences	No. of pods	Mean
Open-pollination	4	71	17·75	4	102	25·50
Caged	4	1	0·25	4	9	2·25
Bagged	8	15	1·87	3	0	0·00

From these preliminary tests, it would seem that the exclusion of large insects forms a fairly effective barrier to cross-pollination.

(c) CHEMISTRY

1. Fertilizer Experiments.

(*a*) *Major factorial experiments.* The first of these experiments was laid down on Table Mountain Sandstone at Honey Grove in 1949. The site is fairly level and the soil is a heavy, sandy loam of good structure and free drainage. The design used was Yates's quasi-latin square with four treatments, each at three levels, in 81 plots. The treatments were:

Nitrogen	*Phosphorus*	*Potassium*	*Lime*
N_0 Nil	P_0 Nil	K_0 Nil	L_0 Nil
N_1 1 cwt./acre	P_1 2 cwt./acre	K_1 1 cwt./acre	L_1 $2\frac{1}{2}$ tons/acre
N_2 2 cwt./acre	P_2 4 cwt./acre	K_2 2 cwt./acre	L_2 5 tons/acre

N = ammonium sulphate
P = superphosphate
K = muriate of potash
L = agricultural lime.

The plots were demarcated in February, 1949, lime was applied in March, and the remaining fertilizers at the end of May of the same year. At first, regeneration was rather patchy, but by a little re-seeding and even, in a few cases, transplanting of seed-

lings, an even stand was obtained. Normal silvicultural practice followed, the plots being progressively thinned to a final stand of 520 stems per acre at three years of age. The trees were measured each year and estimates of treatment effects have been published in previous *Reports*.

A severe bagworm infestation during 1954-55 resulted in complete defoliation of many trees and partial defoliation of the remainder; later wind storms caused further damage. As a result, the stand at harvest was uneven and, in consequence, the number of trees stripped per plot was recorded in addition to the weight of bark obtained. The difficulty of unevenness of stand could then be overcome by analysis of covariance of yield against number of trees. Bark samples for tannin analysis and for moisture content were drawn from the choppers at the factory. The final adjusted yield figures are given in the following table. To avoid the complication of variable moisture content, all bark yield comparisons were made on the basis of moisture-free material.

Treatment	Mean green bark yield (long tons/ acre)	Mean bark yield, moisture-free		Mean tannin yield	
		Long tons/ acre	Significant difference	Long tons/ acre	Significant difference
N_0	9·58	4·79		1·79	
N_1	9·07	4·55	Not significant	1·70	Not significant
N_2	9·15	4·63		1·73	
P_0	8·86	4·41		1·64	
P_1	9·42	4·71	0·28	1·77	0·13
P_2	9·53	4·84		1·80	
K_0	9·34	4·72		1·76	
K_1	9·05	4·52	Not significant	1·68	Not significant
K_2	9·42	4·73		1·77	
L_0	9·13	4·54		1·69	
L_1	9·08	4·55	0·27	1·71	Not significant
L_2	9·60	4·88		1·82	

The only significant bark yield improvements were due to phosphate and lime. The increase from the application of two cwt. super per acre was 0·56 ton green bark, which at £10 per ton is worth £5. 12s. 0d. With superphosphate at £12 per ton on the farm and labour for application at 4s. 6d. per acre, a generous estimate of cost is £1. 8s. 6d. per acre, which leaves a nett return for treatment of £4. 3s. 6d. The four cwt. dressing of superphosphate (P_2) was not significantly better than the two cwt. dressing, so it may be concluded that the optimum economic application is around two cwt. per acre.

With lime, only the double dressing of five tons per acre was significant, the increase in yield of green bark being 0.47 ton per acre, worth just under £5. At a cost for lime of £1 per ton on the farm and a cost of application of about 10s. 0d. per acre, the farmer would pay £5. 10s. 0d. and lose about 10s. 0d. per acre.

Only phosphate produced a significant increase in the yield of tannin per acre, and the heavier dressing was not significantly better than two cwt. per acre.

In no case was there any significant interaction between treatments.

This experiment is being repeated through another cycle with the same treatments to investigate the cumulative effects of the treatments.

It is interesting to note in the following table that the estimates based on annual measurements have indicated trends in treatment effects fairly accurately, but it would be unwise to accept such predictions without reserve. All figures refer to higher levels only of fertilizer.

Estimates of treatment effects compared with actual yields at harvest
(No treatment = 100)

Year	Nitrogen	Phosphorus	Potash	Lime
1950† ..	100	119*	108*	97
1951† ..	100	121*	101	101
1952† ..	100	121*	102	103
1954† ..	100	107*	101	103*
1956†† ..	98	118*	105	108*
1957†† ..	99	116**	105	108*
1959‡ ..	97	110*	100	108*

† Based on height only.
†† Based on estimated bark weight calculated from height and diameter measurements.
‡ Based on actual weight at harvest.
* Difference significant (P = 0.05).
** Difference significant (P = 0.01).

The second of these experiments, on shale at Bloemendal, is to be harvested during the next stripping season and therefore no further interim measurements were made.

The third of the series, on dolerite at Clan Syndicate, gave the following bark yields, the estimates again being based on diameter only because of wind damage:

Estimated bark weight in relation to treatment
(No treatment = 100)

Soil-parent material	Nitrogen	Phosphorus	Potash	Lime
Dolerite ..	102	110*	100	109*

* Difference significant (P = 0·05)

(*b*) *Different forms of phosphate.* The experiment on shale at Bloemendal is to be stripped during the coming season and was not measured. The experiment on dolerite showed no significant differences.

(*c*) *Quantity of superphosphate and method of application.* In this experiment, six rates of application of superphosphate are combined with four methods of application.

The rates are 0, 50lb., 100lb., 200lb., 400lb., and 800lb. superphosphate per acre.

The methods of application are:

A. Half under the seed before sowing; remainder between the lines one year later.

B. Half in bands on either side of the seedling lines at first thinning; remainder between the lines one year later.

C. All under seed before sowing.

D. All in bands on either side of the seedling lines at first thinning.

The design of the experiment is a 4 x 4 latin square for methods of application with plots split for rates.

Estimated green bark weight (tons per acre) at 5 years

Treatment	Superphosphate lb./acre						
	0	50	100	200	400	800	Mean
A	4·83	4·97	4·99	5·40	5·45	5·81	5·24
B	4·64	4·97	4·93	4·94	5·69	5·59	5·13
C	4·95	4·77	5·22	5·63	6·10	5·96	5·44
D	5·04	5·09	4·81	5·41	5·80	5·85	5·33
Mean	4·87	4·95	4·99	5·35	5·76	5·80	

	Quantity	*Method of application*
Standard error	0·323	1·89
Significant difference (P = 0·05)	0·06	0·31
Significant difference (P = 0·01)	0·09	0·42

Once more, the only significant differences are in the rates of application. There is a steady improvement in yield up to 400 lb. superphosphate per acre, but it is probable that the optimum economic dressing is about two cwt. per acre.

(*d*) *Gummosis.* Scoring for severity of gummosis attack in all the fertilizer experiments again indicated no significant differences due to fertilizer.

2. Bark Analysis.

(*a*) *Routine analysis.* Bark samples analysed during the year numbered 530. Of these, 66 were submitted by the Government Inspector of Wattle Bark.

(*b*) *Tree and plot sampling.* The exhaustive survey of pellet sampling methods, which has been carried on for several years, has shown that there is always a slight bias which is often linked with treatment and is not consistent. If the bias were constant, it would be a comparatively simple matter to calculate a conversion factor, but where the bias is subject to variation due to either silvicultural or fertilizer treatment, no factor would be reliable.

Another difficulty is that because of variations in the rate of drying of the bark between stripping and weighing, due to variations in the speed of working of different strippers and in atmospheric conditions such as relative humidity, temperature, and wind, samples taken direct from the tree do not bear a constant relation to the total bark as weighed.

For these reasons and because the heavy stripping programme precluded further trials, it was decided to drop, for the time being, all attempts to obtain true samples from the plots in the field and to try to obtain a sample at the factory during chopping. The most suitable layout for this is where the bark is carried from the choppers to the extractors on an endless belt.

Before any of the Institute experiments were stripped, preliminary tests were carried out to find out how much moisture was lost during chopping under different humidity conditions, and the variation in the samples taken from the endless belt for tannin analysis. During these tests, it was found that

(*a*) bark in bundles did not lose more than 0·25 per cent. moisture per hour whilst awaiting chopping,

(*b*) the loss of moisture during chopping was never higher than 1 per cent. when a three bladed "Papec" machine was used. The loss was higher with the six bladed machine,

(*c*) the rate of loss of moisture could not be correlated with temperature and humidity measurements inside the factory.

As a result of these tests, it was decided to weigh the bark as near to chopping time as possible, to note the time interval between weighing and chopping, and to use only the three bladed chopper, so that a reasonable correction factor for moisture could be applied. Random duplicate samples of about 300 g. each for moisture were taken in tared bottles at the end of the delivery pipe and random duplicate samples for tannin analysis, about 3 per cent. of the total bark, were taken from the belt. The standard error of the mean of two readings from each plot, calculated from 161 pairs of samples, was 0·42 per cent. for moisture and 0·46 per cent. for tannin.

3. Variation in Percentage of Tans and Non-Tans with Age.

Details of the experimental layout and method of harvesting at six-weekly intervals were given in last year's report. The average measurements of the trees harvested at three and four years of age are given below.

	3 Years	*4 Years*
D.B.H. (inches)	3·0	3·7
Height (feet)	31·2	37·7
Dry bark weight (lb.)	4·0	7·6

The analytical figures covering the two year period are given in the table below; the tan and non-tan figures are the average of four plots harvested at the same time.

Time	Tan per cent.		Non-tan per cent.		Tan/non-tan ratio	
	3 years	4 years	3 years	4 years	3 years	4 years
October ..	35·4	36·2	14·3	16·2	2·5	2·2
November ..	36·0	36·0	12·9	14·4	2·8	2·5
January ..	34·6	37·5	13·0	13·1	2·7	2·9
February ..	35·3	35·4	12·5	14·0	2·8	2·5
March	33·0	35·8	14·5	14·7	2·3	2·4
May	32·6	36·0	14·9	14·8	2·2	2·4
Mean	34·5	36·1	13·7	14·5	2·6	2·5

The difference in tan percentage between the two years is significant (P = 0·05).

In the case of the non-tan percentages, significant differences (P = 0·01) were found between years, between harvestings, and with interaction between years and harvestings. This is in accord with earlier observations (*Report for 1956–1957*) that the content of non-tans is influenced by rainfall.

The rainfall figures in millimetres recorded at a weather station near the experimental area are given in the following table.

	3rd Year	*4th Year*
August	39·3	10·6
September	163·4	67·1
October	206·6	43·7
November	74·8	179·2
December	89·0	189·2
January	157·5	185·8
February	178·3	139·4
March	55·7	63·5
April	142·9	58·6
	1,108·1	937·1

Because of the heavy rains in September and October in the third year, the non-tan percentages recorded for October and November in that year were very much lower

than in the corresponding periods in the following year. This, in conjunction with the greater rainfall in the third year, resulted in a lower mean non-tan percentage recorded for the younger trees.

The non-tan percentages recorded for the two years are no higher than those found previously in mature trees from Bloemendal.

4. Trace Element Experiments.

In harvesting experimental plots, it was observed that growth and tan percentage differences which could not be correlated with treatment often occurred. Since, in the majority of these experiments, regeneration was effected by sowing, the variation observed could hardly be due to variation in genetical constitution, but was more probably the response of the genotype to the environment.

Several workers have found that in some cases where response to balanced fertilizer application is low, the limiting factor is the low availability of trace elements. Further, fertilizer experiments have shown that wattle responds significantly only to light applications of superphosphate. It was, therefore, decided to put down two pilot trace element experiments to obtain some indication of the response of wattle.

In the first experiment, the leaf-spray technique of application was used. No significant effects either on tan percentage or tree growth were recorded. In the second, seeds were soaked in trace element solution for 24 hours. They were planted on 13th October, 1958, and the young trees harvested on 24th May, 1959. No significant differences were observed, but the plots were unduly affected by root and shade effects of a mature tree growing nearby.

The work will, therefore, be repeated.

5. Chemical Composition of Non-Tans.

Crystalline acetone and acetyl derivatives of the polyalcohol previously reported have been obtained.

Glucose has been separated from fructose using heavy paper chromatography. No further work has been done on the non-tan polyphenols.

6. Tannin in Wattle Seedlings.

Williams (1928) reported that the bark from one-year old wattle trees contained only 3·9 per cent. tans. This result, however, is by no means representative, since current work has shown that the bark from five-months old trees may have 16 per cent. tans (average of 48 trees) while nine-months old trees with 23 per cent. tans have been encountered. It would appear, therefore, that tannin is laid down early in the seedling stage.

Examination of untreated seeds of black wattle showed that, when stripped of their testas, they were free from tannin. Further, no polyphenols capable of reacting with the reagents vanillin/HCl, 70 per cent. H_2SO_4, or potassium ferricyanide/ferric chloride could be detected on paper chromatograms.

It was consequently decided to investigate the aqueous extract of seedlings at intervals to ascertain at what stage in the growth of the plant tannin in formed. Once this has been ascertained, a study of the actual formation of tans could be undertaken.

The coloured portions of stems, without the leaves, from twelve-day old seedlings were extracted and the polyphenols in the extract precipitated by lead acetate in the usual way. The polyphenols comprised yellow, brown, and pink compounds. Most of the yellow fraction was separated from the other material on a cellulose column using 0·1N ethanolic hydrochloric acid as solvent. This was further separated into four bands located in U.V. light.

The material remaining on the column was removed with 2N hydrochloric acid and re-chromatographed on cellulose, using butanol/2N HCl solvent. Although this material was resolved into six bands, the first brown, the second brown and pink, the third, fourth, and sixth pink, and the fifth yellow, paper chromatography showed

each band to be a mixture. Subsequent chromatography of each band on 3 mm. paper and elution of individual components gave minute amounts of amorphous material which have not yet been identified.

REFERENCE

Williams, C. O. (1928). South African tanning materials. Part I. The black wattle. *S. Afr. Dep. Agric. Sci. Bull.* No. 63, p. 34.

(d) ENTOMOLOGY

1. Effect of Bagworm Attack on Increment.

Increment plots were checked at the end of 1958 and again examined and measured in co-operation with the Silviculture Section during July, 1959. The plots at Mowbray, which were lightly infested with bagworms (degree 2 to 3) in 1952 at the age of $2\frac{1}{2}$ years, were harvested and the bark weighed. There was no significant difference between the infested plots and those kept free of bagworms.

2. Chemical Control.

(*a*) *Commercial spraying campaign, 1958-59.* Over 5,000 acres were surveyed and 3,087 selected for aerial treatment. In all, 3,266 acres were sprayed and the application was supervised over 2,403 acres. The insecticide used was toxaphene dissolved in light diesel oil at the rate of 0·75 lb. per gallon of solution; 1,320 acres were treated with 2 gals./acre and the remainder with 3 gals./acre. The aircraft used was a 295 h.p. Percival E9 monoplane, equipped with 41 type D8 spray nozzles and with a tank holding 180 gals. of insecticide. Usually only 90 gals. were carried on one flight, with a few exceptions when plantations growing at lower altitudes were sprayed very early in the morning; the load then consisted of 135 gals. The plane, flying at 90 m.p.h., used a pressure of 35 lb./sq. in. to apply 2 gals. per acre and 45 lb. when discharging 3 gals. The campaign started on 12th and was concluded on 21st November, 1958. In all, there were 6 spraying days, the actual time of flying and spraying being 26 hrs. 6 mins., or 4 hrs. 21 mins. of flying and spraying per day. The average daily total was 500 acres, i.e. slightly less than 2 acres per minute of flying time (1·72 acres per minute when spraying 3 gals./acre and 3·04 acres per minute with 2 gals.). No "swathing" flags were used, and nearly all plantations were marked off into blocks of 50 acres or less.

The outcome of the campaign was assessed over 3,146 acres. The plantations were surveyed from the air and, in some doubtful cases, from the ground also. The aerial survey (from Port Shepstone to Piet Retief and Swaziland) was completed in eight flying hours, against an estimated 14–16 days for ground survey, with a saving of some 25 per cent. in costs. The general outcome of the spraying was satisfactory when the recommended dosages were applied. On only some 30 acres, or approximately 1·2 per cent., was there unsatisfactory control. This was due to operational faults on approximately 5 acres; in the remaining 25 acres, the failure was traced to biological factors.

(*b*) *Effect of insecticidal spraying on wattle insects other than bagworm.* The experiment which started on 21st October, 1957 (*Report for 1957-58*, p. 25), was concluded in the field on 2nd February, 1959, and the window flight traps have been dismantled. The number of insects collected up to July, 1958, i.e. in 8 months after spraying, was always lower in plantations treated with insecticide, except in the seven days immediately after spraying. From August, 1958, onwards, the population in the treated plantations increased and from October, 1958, until February, 1959, was nearly always the same as in the untreated control plantation.

A second set consisting of eight window flight traps was erected on 18th September, 1958, in a plantation in the Eston-Richmond area and part of the plantation was sprayed on 13th November, 1958. The number of insects collected up to the end of August,

1959, i.e. in 9 months after spraying, was again always lower in plantations treated with insecticide, except in the 6 days immediately after spraying. Collection will continue for another season.

3. Biological Control (Virus Disease in Bagworms).

(*a*) *Experiments, 1955 and 1956.* The long-term effect of the virus treatment in plantations where the experiments were carried out is being studied.

(*b*) *Experiments, 1957.* In this experiment, it was found that when the infestation was in the prodromal stage and the larvae were in their first instar at the time of treatment, there was no marked difference in mortality whether the suspensions contained 1,000 or 500 virus polyhedra/cu. mm. Concentrations of 250 polyhedra/cu. mm. gave a lower kill, but mortality was still high enough to keep the crowns of the trees green. With the higher concentrations, the progress of the cycle was greatly accelerated and the eruptive stage and the crisis occurred later in the same season, whereas with the lowest concentration, the infestation decreased gradually after spraying. Against older larvae, the initial mortality was too low to prevent defoliation, but nine months after spraying, the mortality had increased sufficiently to reduce the infestation to its basic level.

Where virus was applied during the eruptive stage, there was a very high initial mortality and defoliation of trees was light, whereas untreated trees were completely defoliated. Nine months after spraying, however, mortality was equally high in treated and untreated plantations.

The kill up to about six months after spraying was consistently higher where virus of introduced stock was applied than with suspensions containing local material or a strain of suspected low virulence. Nine months after treatment, there was no difference between introduced and local virus, but the virus of low virulence, although an introduced strain, still gave a lower kill. When applied at the prodromal stage of infestation, the introduced virus was more effective than the others in preventing defoliation and so avoiding loss of bark and wood increment.

Methyl cellulose used as a sticker made no appreciable difference to mortality, but skim milk powder reduced it because of adverse effects on the suspension.

A paper reporting this experiment has been accepted for publication (Ossowski, 1960).

(*c*) *Experiments, 1958.* Experiments were carried out to test the virulence of various strains of the nuclear polyhedral virus of *K. junodi*, including virus material collected from bagworms of the thornveld and a virus of the cotton bollworm, *Heliotis armigera* from Uganda. Two sets of experiments were conducted at the time of hatching of bagworms, one in a plantation with a low population and the second in a stand with a high population. A third experiment was carried out at the time when bagworms were mainly in their second or third instars. Assessment of the results is in progress.

4. Identification of Wattle Insects.

Nine insects hitherto not recorded as potential wattle pests were observed and identified. They are listed under Nos. 142, 152, 177, 192, 198, 201, 203, 204, and 206 in the article on page 32 of this Report.

5. Records of Insect Outbreaks.

The records at present contain data concerning 60 species on 250 farms.

REFERENCE

Ossowski, L. L. J. (1960). The Biological Control of the Wattle Bagworm, *Kotochalia junodi* (Heyl.), by a Virus Disease. Part II. Large-scale Experiments. *Ann. app. Biol.* (in the Press).

(e) MISCELLANEOUS

1. Weed Control by Chemical Means.

Larger scale experiments have confirmed the efficacy of a solution of 2:4:5-T ester in diesel oil as a basal spray for the control of aspen (*Populus tremula*). There are indications that the much cheaper 2:4-D may also be effective, but it is as yet too soon after treatment to be sure of this.

2. Collaboration with other Organizations.

(*a*) *Studies on ground-water movement.* Following the survey mentioned on page 7, a joint study of ground-water behaviour has been started in collaboration with the Geological Survey. A borehole is to be sunk and equipped with recording instruments to make possible continuous observations on the movement of the water table in relation to the growth of trees on the surrounding area. These observations will be continued through several cycles of the wattle crop and will form a most useful supplement to the information gained from the run-off and erosion experiment.

(*b*) *Studies on the tannins of wattle species.* Samples of silver wattle bark were collected at different times during the year for use in analytical studies at the Leather Industries Research Institute.

PROGRESS REPORTS AND PAPERS

AN ANNOTATED LIST OF WATTLE INSECTS AND SPIDERS OF SOUTHERN AFRICA

By L. L. J. OSSOWSKI and G. B. WORTMANN

An account is given of wattle insects and spiders observed or collected during the period 1949–1959.

The present list is based on a survey of wattle arthropods covering the period 1949-1959 and includes all species observed or collected in the course of the Institute's work in wattle plantations in Southern Africa. The opportunity has been taken to include also beetles (102, 137) found damaging black wattle seed received from Australia.

The material is listed by natural orders and families, the latter being arranged alphabetically under their orders. Where known, common English and Afrikaans names of families and species have been added.

A. CLASS: INSECTA

I. ORDER: LEPIDOPTERA

Family: *Arctiidae;* Tiger Moths, Tiermotte

1. *Diacrisia* (*Spilosoma*) *eugraphica* Wlk. Brown Woolly Bear, Bruinwolhaarrusper.
2. *D.* (*S.*) *lutescens* Wlk. Black Woolly Bear, Swartwolhaarrusper.

These two species, of which the latter is the more common, are very often to be seen in wattle plantations, expecially on younger trees. Apart from defoliation of some 10 acres of six-months old wattles in 1952, no damage of economic importance has been observed.

Family: *Cossidae;* Carpenter or Goat Moths, Houtboordermotte

3. *Gymnelema vinctus* (Wlk.). Crossed-stick Bagworm, Dwarsstoksakwurm.

This insect, though quite common in wattle plantations, is not a serious pest, since it feeds mainly on grass and wattle undergrowth. The bag is built of grass, little twigs, or the midribs of leaves, which are fastened at approximately their middle, tangentially to the casing. Each stick crosses over the end of the preceding one and the whole bag assumes a pentagonal form, the diameter of the bag increasing toward its upper part.

Family: *Geometridae;* Loopers, Landmeterruspers

4. *Semiothisa simplicilinea* Warr. (Pl. I, fig. 6).
5. *S. umbrata* Warr.

Family: *Lasiocampidae;* Lappet Moths, Lapelmotte

6. *Anadiasa punctifascia* Wlk. Small Wattle Lappet Moth, Kleinwattellapelmot.

This insect is very common in wattle plantations, and outbreaks appear to occur every four to five years, when trees are completely defoliated and damage becomes serious. The larvae are gregarious, clustering together in the daytime and spreading over the tree at night for feeding. Their hairs cause irritation to the human skin. There are two generations each year and damage done to younger trees is considerable, especially by the summer generation, when larvae are feeding for some three months.

This generation pupates among leaves at the ends of small branches, while cocoons of the winter generation are to be found in crevices behind the bark of dead or damaged trees. The larvae are parasitized by tachinids (91, 93), an ichneumon of the *Charops* species (53), and by shield bugs (210–214); wasps of the family *Sphegidae* (66, 68) are predacious upon all larval instars.

7. *Catalebeda cuneilinea* Wlk.

8. *Gonometa postica* Wlk. Large Lappet Moth, Grootlapelmot, Doringrusper (Pl. I, fig. 4).

This polyphagous lasiocampid seems to infiltrate plantations from the thornveld, and the population in wattle plantations is steadily increasing and damage becomes more widespread. The insect has one generation in a year and the larvae are solitary feeders. Both larvae and pupae are parasitized by hymenopterous parasites (43, 58) and tachinid flies (92, 94). In 1952, a polyhedral wilt disease was responsible for a decrease in the number of larvae in the Hilton Road district.

9. *Mesocelis montana* Cram.

This insect has not until recently been known to damage wattles, its food being confined to indigenous shrubs. Lately, however, more than 300 acres of wattle plantations were attacked in the Transkei, of which 200 were partially defoliated. There is one generation per year, and pupae in large, oval, parchment-like cocoons, covered with bristles, can be found under stones or in crevices of thick bark on the lower parts of older trees.

10. *Pachypasa* (*Braura*) *capensis* Aur. Brown Lappet Moth, Bruinlapelmot.

The brown lappet moth, which also attacks *Pinus patula*, is to be found mainly in the Cape Province, though it occurs in Natal too. Its bionomy is similar to that of the small (6) and grey (11) wattle lappet moths.

11. *P.* (*B.*) *truncata* Wlk. Grey Wattle Lappet Moth, Gryswattellapelmot (Pl. I, fig. 3).

This moth is widespread throughout the wattle belt generally, but usually seems to be more abundant during or after wet seasons. Outbreaks recur every three to six years. Damage then becomes very serious, since the larvae, being larger than those of *A. punctifascia* (6), defoliate bigger trees too. There are two generations in each year. Numerous diptera (89, 90–93, 98) and hymenoptera (39, 41, 42, 61, 62) parasitize larvae and pupae. Shield bugs (211–214) and wasps (*Sphegidae*) (66, 68) also prey upon the larvae.

12. *Pseudometa dollmanni* Tams.

This insect, which up to 1949 had been recorded as feeding only on indigenous trees of Southern Africa, in that year invaded some 300 acres of plantations in the higher wattle belt of Southern Rhodesia and thirty acres were completely defoliated. A recurrence of the invasion took place in 1956, when some 20 acres of younger trees were defoliated. So far, no damage to trees older than eighteen months has been observed.

Family: *Limacodidae;* Cup Moths, Brandruspermotte

13. *Coenobasis amoena* Feld. Cup-and-Saucer Moth.

The larvae are parasitized by a eurytomid (50) and a cuckoo or jewel wasp (46).

Family: *Lycaenidae;* Blues, Coppers, Hairtails, Bloutjies, Kopervlerke, Kortstertjies

14. *Lachnocnema bibulus* F.

Family: *Lymantriidae;* Tussock Moths, Pluimhaarwurmmotte

15. *Euproctis hardenbergia* Janse.

Family: *Lyonetiidae;* Ribbed-case Bearers, Geriffeldekokerdraers

16. *Opogona* sp.

Family: *Noctuidae* (*Agrotidae*); Owlet Moths, Uile

17. *Achaea lienardi* Boisd. Wattle Noctuid, Castor-oil Caterpillar, Watteluil, Kasterolierusper (Pl. I, fig. 2).

This noctuid was first reported in 1915 to damage wattle trees. Since then, de-

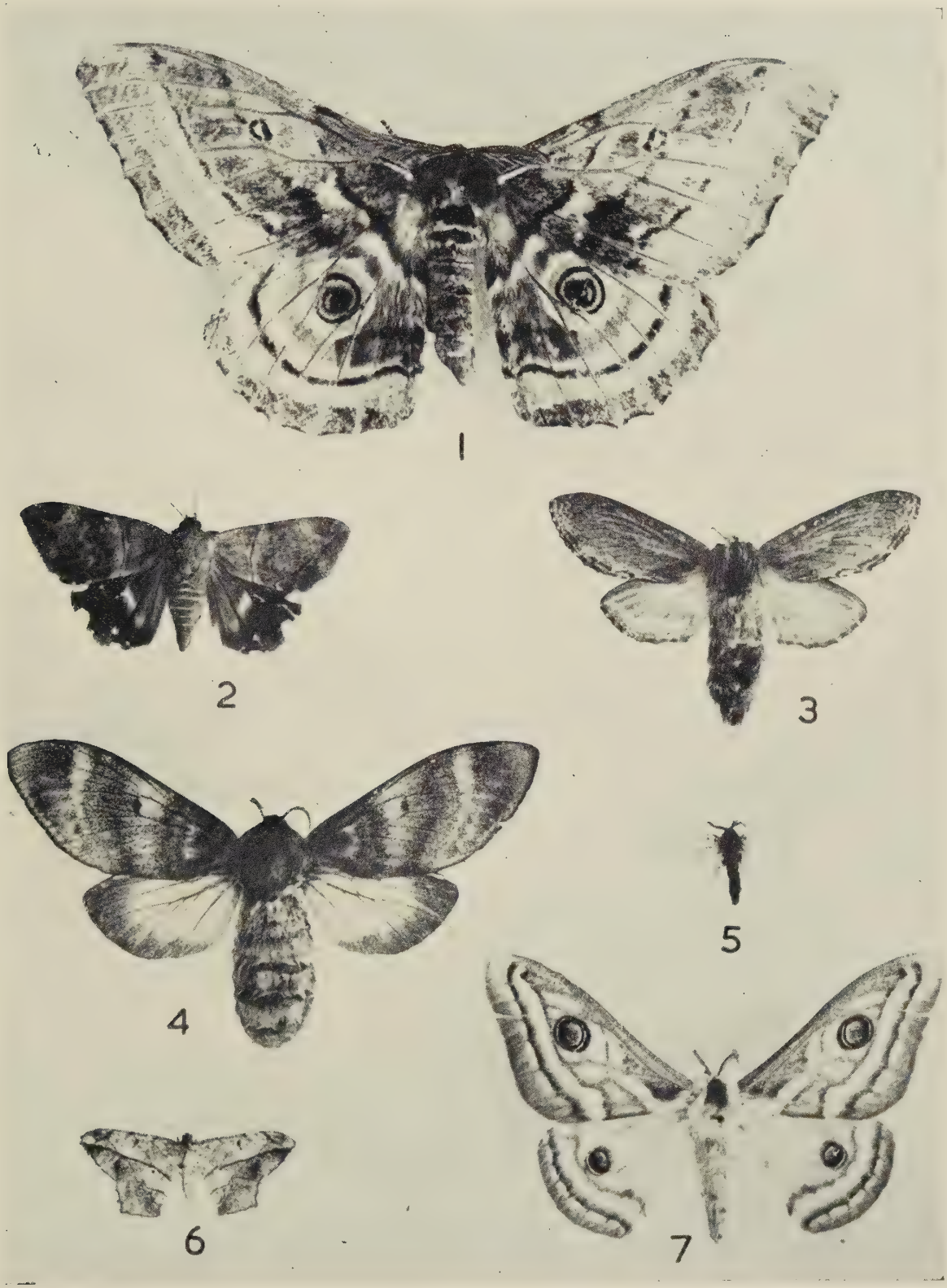
PLATE I

LEPIDOPTERA

1—Gynanisa maia (25)*, 2—Achaea lienardi (17), 3—Pachypasa truncata (11), 4—Gonometa postica (8), 5—Kotochalia junodi, male (32), 6—Semiothisa simplicilinea (4), 7—Heniocha apollonia (23).

Approximately natural size.

* The number in brackets indicates the number of the insect on the list.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foliation has occurred at intervals of four to six years. Damage to trees was particularly heavy in 1952 and 1956 when, in each season, nearly 6,000 acres were infested, of which 4,000 acres were partially or completely defoliated. Depending on climatic conditions, there are one or two and sometimes even three generations in one year, but two defoliations in one year usually occur only after late summer rains. The larvae live mainly gregariously and their colour is then light brown or black; the colour of solitary specimens is white, whitish, or pink. The wattle noctuid has many enemies among the *Tachinidae* (95, 99), *Sphegidae* (66, 68), and *Pentatomidae* (210–215). Birds are also instrumental in reducing this pest.

18. *Agrotis segetum* (Schiff.). Common Cutworm, Gewone Snywurm.

19. *Euxoa longidentifera* Hmps.

20. *Laphygma exempta* Wlk. Army Worm, Komandowurm.

The army worm, which is reputed to feed only on plants belonging to the grass family, has lately also attacked wattle seedlings intercropped with maize. The larvae fed first on grass, then attacked the maize, and finally the wattle seedlings.

21. *Pericyma mendax* Wlk.

Larvae are frequently to be found in plantations of all ages, but only lately has damage become noticeable, and this only in very young stands. The larvae are heavily parasitized by a tachinid fly (88).

22. *Simplicia inflexalis* Guen.

Family: *Saturniidae;* Emperor Moths, Pouoogmotte

23. *Heniocha apollonia* (Cram.). Pale Wattle Saturnid, Witwattelpouoogmot (Pl. I, fig. 7).

This moth is found generally in wattle plantations, but is never very abundant.

24. *Gonimbrasia tyrrhea* Cram. Willow Tree Emperor Moth, Wilgerboompouoogmot.

This saturnid was first reported in 1891, having been observed feeding on wattles in the Transkei. It soon became a major wattle pest there, defoliating trees over considerable areas. Where wattle plantations, formerly infested by this moth, were felled and replaced by eucalypts, no further infestation was observed. A braconid (38) was found to parasitize larvae of this moth.

25. *Gynanisa maia* (Klug). Wattle Emperor Moth, Wattelpouoogmot (Pl. I, fig 1).

This species is fairly common in younger wattle plantations. The larvae are voracious feeders, and the damage done by defoliating smaller wattle trees is considerable. Defoliation of larger areas was first reported in 1912 from plantations around Pietermaritzburg. Depending on climatic conditions, there are one or two generations in one year. The most common parasite of this saturnid is a braconid, *Apanteles maculitarsis* Cram. (39). A *Mesocomys* sp. (48) parasitizes the eggs of this moth. Crows are also instrumental in reducing the larval population, and in 1952, a polyhedral wilt disease was responsible for checking an infestation.

26. *Nudaurelia cytherea capensis* Stoll. Pine Emperor Moth, Dennepouoogmot.

This is primarily a pest of pines, but has recently started to attack black wattle in the Transkei.

27. *N. wahlbergi* Boisd.

The host plants of this insect are mainly indigenous shrubs, but in 1952, larvae invaded some wattle plantations, A few trees were defoliated, but in general this insect is so far not regarded as a wattle pest.

Family: *Tineidae;* Clothes (True) Moths, Kleremotte

28. *Melasina halieutis* Meyr. Thorn Bagworm, Doringsakwurm.

For the first time, this bagworm was reported in 1958 to have damaged wattle plantations in Zululand. Little is known of its life cycle, but since newly-hatched larvae are to be found in October and February, it may be assumed that there are at least two generations per annum. For building their bags, the larvae use nothing but the fine particles of the leaf or bark on which they feed. These particles are arranged

in smooth, narrow rings, accurately joined together and increasing in diameter towards the mouth end, which form a bag shaped like a smooth greyish-brown thorn.

29. *M. tyrophanes* Meyr. Clear Spiral Bagworm, Helderspiraalsakwurm.

The bag of this species consists of small sticks arranged at a slight angle and increasing in length towards the upper part of the bag, which assumes a spiral form. There seem to be two generations per year. The larvae feed mainly on grass and wattle undergrowth and so far have not been regarded as a serious wattle pest. In 1953 and 1954, however, they were reported to have seriously damaged young wattle trees, though not over a large area. The larvae are parasitized by a chalcid (45) and several ichneumons (54, 55, 60).

Family: *Tortricidae;* Tortrix Moths, Leaf Rollers, Bladrollers

30. *Polychrosis incultana* Wlk. Wattle Webworm, Wattelspinwurm.

The wattle webworm first became abundant in wattle plantations around 1938. There seem to be several generations at intervals of approximately four weeks during the summer and early autumn months, the November-December generation seeming to produce the largest progeny. The larvae feed without leaving the very conspicuous nest, which consists of leaves fastened together with silk. The damage done is frequently serious, especially since outbreaks of this pest usually coincide with attacks of jassids and capsids. A braconid (37), so far unidentified, attacks this insect. Birds also, especially the green white eye, *Zosterops virens virens*, feed on the larvae and pupae.

Family: *Psychidae;* Bag or Case Moths, Sakwurms.

31. *Clania moddermanni* (Heyl.). Lictor Bagworm, Stokkiesakwurm.

In recent years, this psychid has become more abundant in wattle plantations. Its bag consists of small sticks rounded off at both ends and attached lengthwise to the bag. The sticks are not all equally long, and usually two extend for a considerable distance beyond the bag, probably to protect the insect from being pulled out by birds and other enemies.

32. *Kotochalia junodi* (Heyl.), formerly *Acanthopsyche junodi* Heyl. Wattle Bagworm, Wattelsakwurm (Male Pl. I, fig. 5).

The wattle bagworm is the commonest and most destructive of all wattle pests. The building up of an infestation, which requires some 5–7 years to reach its peak, after which it returns to its latent (basic) stage,* i.e. when there are practically no bagworms in a plantation, depends mainly on climatic conditions and nutritional, plant physiological, and other environmental factors. The latent (basic) stage, is usually followed by two years of the initial or preparatory stage, when bagworms become more numerous. After that, the infestation enters the prodromal or premonitory stage, during which the population increases rapidly. This stage lasts, as a rule, two years. Then follow the eruptive stage, lasting from one to three years, the crisis, and the abatement, when the infestation returns to its latent stage.

Isaria (white) and *Entomophthora* (brown) fungus and a nuclear polyhedral virus are responsible for a high proportion of the natural bagworm mortality. Hymenopterous (44, 47, 52, 58, 59) and dipterous (86, 96, 97) parasites are fairly prevalent

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* Hitherto we have used the term "endemic" for this stage, following Graham's *Principles of Forest Entomology* (1952, p. 89). This, however, appears to be an incorrect usage, since according to Torre-Bueno's *A Glossary of Entomology* (1937, p. 87), Chambers's *Technical Dictionary* (1943, p. 296), and other authorities, endemic means prevalent in, confined or peculiar to a particular country, region or district. Voûte (*Arch. Neerl. Zool.*, 1947, 7, pp. 435–470) calls this stage "natural density", and Schwerdtfeger, in *Über den Verlauf von Insektengradationen* (1933, pp. 32–41), calls it "Normalbestand". Schwerdtfeger, however, in his *Waldkrankheiten* (1957, p. 267) suggests that these terms should not be used, since they imply that a high population level is unnatural or abnormal, and he proposes the term "Latenzbestand".

We are, therefore, now using the terms latent or basic, the former being more appropriate for this particular *stage* of the infestation, and the latter for the *population* during that stage.

on bagworms. Some *Coleoptera* (124, 151, 164), *Psocoptera* (225–227), *Hemiptera* (213, 214), and *Araneae* (230, 231, 234–236, 238–241) also prey on bagworms and several birds and small rodents feed on larvae and pupae.

Family: *Xyloryctidae*

33. *Odites* sp. ? *natalensis* Wats.

II. ORDER: HYMENOPTERA

Family: *Apidae;* Bees, Bye

34. *Apis mellifera* L. *unicolor* Latr.

35. *A. mellifera* L. *adansoni* Latr.

Family: *Halictidae;* Sweat or Flower Bees, Sweetbye

36. *Halictus* sp.

Family: *Braconidae;* Braconids, Braconiedewespe

37. *Apanteles* sp. indet., a parasite of *P. incultana* (30).

38. *A. aethiopicus* Wilkinson, a parasite of *G. tyrrhea* (24).

39. *A. maculitarsis* Cram., is polyphagous, having been found to parasitize *G. maia* (25) and *P. truncata* (11).

40. *Ipobracon luctuosus* Brullé (Pl. II, fig. 8).

41. *Meteorus* sp., a parasite of *P. truncata* (11) and *P. capensis* (10). This braconid has a second host in which it passes the winter.

42. *Troticus rufa* Cam., a parasite of *P. truncata* (11) (Pl. II, fig. 5).

Family: *Chalcididae;* Chalcids, Dikbeenparasietwespe

43. *Brachymeria* sp. indet., a parasite of *G. postica* (8).

44. *B. polyctor* Wlk., a parasite of *K. junodi* (32).

45. *Hockeria* or a related genus, a parasite of *M. tyrophanes* (29).

Family: *Chrysididae;* Cuckoo or Jewel Wasps, Koekoekwespe

46. *Chrysis* (*Pentachrysis*) sp., a parasite of *C. amoena* (13) (Pl. II, fig. 7).

Family: *Eulophidae*

47. *Tetrastichus* sp. indet., a parasite of *K. junodi* (32).

Family: *Eupelmidae*

48. *Mesocomys* sp. nr. *vuiletti* Crawf. was found to parasitize eggs of *G. maia* (25).

Family: *Eurytomidae;* Eurytomid Wasps or Seed Chalcids, Saadwespe

49. *Eurytoma* sp. This wasp is a hyperparasite of *C. evolans* (86).

50. *Eurytoma* sp. n., a parasite of *C. amoena* (13).

Family: *Formicidae;* Ants, Miere

51. *Anoplolepis custodiens* Sm. Pugnacious Ant, Malmier.

Family: *Ichneumonidae;* Ichneumons, Ichneumonwespe

52. *Charitopimpla sericata* (Krchb.), formerly *Philopsyche abdominalis* Morley. The Wattle Bagworm Ichneumon, Wattelsakwurmichneumon (Pl. II, fig. 10).

This ichneumon is an obligatory parasite of *K. junodi* (32). Its life cycle occupies about six weeks and there are five overlapping generations per year, the parasite overwintering as a final instar larva in the larval case of the host.

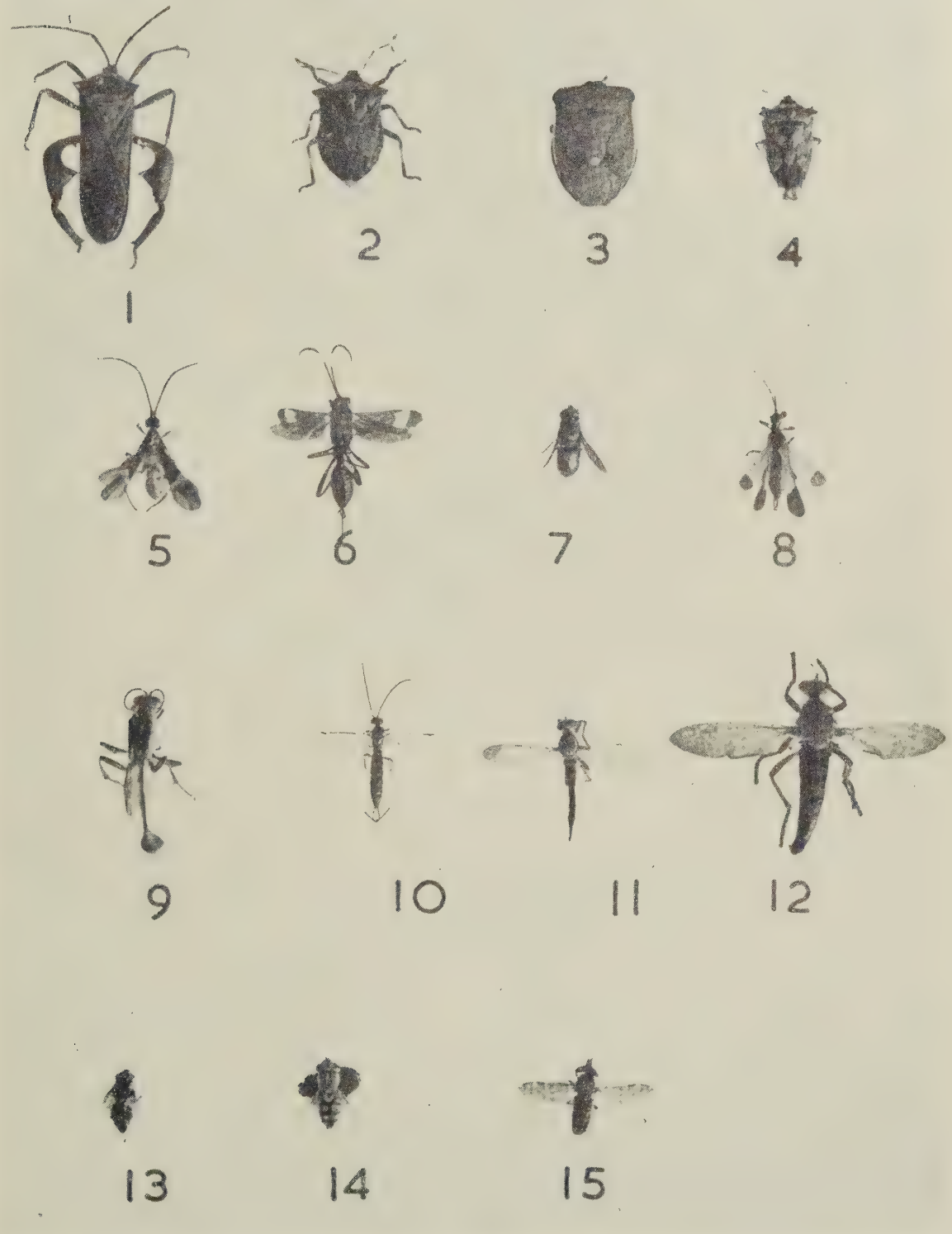
53. *Charops* sp. indet. This species is an important parasite of *A. punctifascia* (6)

PLATE II

HEMIPTERA : HYMENOPTERA : DIPTERA

1—Anoplocnemis curvipes (201), 2—Glypsus maestus (214), 3—Dalsira costalis (212), 4—Macrorhaphis spurcata (215), 5—Troticus rufa (42), 6—Oneilella sp. nr. formosa (58), 7—Chrysis sp. (46), 8—Ipobracon luctuosus (40), 9—Amnophila beniniensis (66), 10—Charitopimpla sericata (52), 11—Neomacherus sp. (71), 12—Microstylum ignobile (72), 13—Tachina fasciata (96), 14—Sturmia imberbis (92), 15—Haematopota obscura (85).

Approximately natural size.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and has frequently been instrumental in reducing the larval population of this lasiocampid to its basic level. *Charops* has a secondary ichneumon parasite (57).

54. *Hemiteles, s.l.* sp., a parasite of *M. tyrophanes* (29).

55. *Itoplectis melanospila* Cam., a parasite of *M. tyrophanes* (29).

56. *I. tosquineti* Dalla Torre.

57. *Lienella* sp. This is a secondary parasite of the *Charops* sp. (53).

58. *Oneilella* sp. nr. *formosa* Brullé (Pl. II, fig. 6). This ichneumon is polyphagous, having been found to parasitize *K. junodi* (32) and *G. postica* (8).

59. *Pimpla crocata* Tosq., a parasite of *K. junodi* (32).

60. *P. heliophila* Cam., a parasite of *M. tyrophanes* (29).

61. *P. mahalensis* Gibrodo, a parasite of *P. truncata* (11).

62. *Theronia lurida* Tosq. (= *trivittata* Krieg), a parasite of *P. truncata* (11).

Family: *Mutillidae;* Velvet "Ants", Valsmiere

63. *Dasylabroides metatarsalis* Bisch.

Family: *Pompilidae;* Spider-hunting Wasps, Spinnekopjagters

64. *Hemipepsis hilaris* Sm.

65. *Priocnemis clypeatus* Arn.

Family: *Sphegidae.* Digger or Sand Wasps, Sandwespe

66. *Ammophila* (formerly *Sphex*) *beniniensis* Pal. Beauv. Caterpillar-Killer Burrowing Wasp (Pl. II, fig. 9).

These wasps prey mainly on lepidopterous larvae and have frequently been responsible for checking infestations of *A. punctifascia* (6) and *A. lienardi* (17).

67. *Palarus latifrons* Kohl.

68. *Philanthus loefflingi* Dahlb., a predator on *A. lienardi* (17) and other lepidopterous larvae.

69. *Philanthus* sp. Bee Pirates, Byevangers.

Family: *Tiphiidae;* Tiphiid Wasps, Lentekewerparasiete

70. *Tiphia* sp.

III. ORDER: DIPTERA

Family: *Asilidae;* Robber Flies, Rowervlieë

71. *Neomachterus* sp. (Pl. II, fig. 11).

72. *Microstylum ignobile* Loew. (Pl. II, fig. 12).

73. *Neolophonatus* (*Lophopeltis*) sp.

74. *Synoleus tenuiventris* Loew.

Family: *Bibionidae;* Harlequin Flies, Harlekynvlieë

75. *Bibio melanogaster* Wied.

Family: *Calliphoridae;* Blow Flies, Skaapbrommers

76. *Chrysomia albiceps* Wied.

77. *C. chloropyga* Wied.

78. *Phumosia* (*Paratricyclea*) *nudiuscula* Big.

Family: *Muscidae;* House and Stable Flies, Huis- en Stalvlieë

79. *Helina* (*s. str.*) sp. indet.

80. *Musca* (*Eumusca*) *lusoria* Wied.

81. *Muscina stabulans* (Fall.), a parasite of *E. mashona* (171).

Family: *Sarcophagidae;* Flesh Flies, Vleisvlieë

82. *Sarcophaga* sp., a parasite of *P. truncata* (11).

Family: *Sciaridae;* Dark-winged Fungus Gnats, Donkervlerkswammuggies

83. *Sciara stigmatopleura* Edw.

Family: *Otitidae;* Pictured-wing Flies, Prentvlerkvlieë

84. *Adapsilia* sp.

Family: *Tabanidae;* Horse Flies or Clegs, Perdevlieë

85. *Haemotopota obscura* Loew. (Pl. II, fig. 15).

Family: *Tachinidae;* Tachinid Flies, Sluipvlieë

86. *Carcelia evolans* Wied. This fly is a very common parasite of *K. junodi* (32).

87. *Dexia* sp. indet., a parasite of *E. mashona* (171).

88. *Pales coerulea coerulea* Jean., a parasite of *P. mendax* (21).

89. *Sericophoromyia quadrata* Wied. This fly parasitizes *P. truncata* (11) and probably also other lasiocampids.

90. *Siphona* sp. ? *reducta* Mesn.

91. *Sturmia* (*Prosturmia*) *idonea* B.B. This fly is polyphagous, having been found to parasitize mainly lasiocampids, particularly *P. truncata* (11) and *A. punctifascia* (6).

92. *S.* (*P.*) *imberbis* (Wied.) (Pl. II, fig. 14), a parasite of *P. truncata* (11).

93. *S.* (*P.*) *patruelis* Mesnil 1949. This parasite is polyphagous, having been found on *P. truncata* (11) and *G. postica* (8). It probably parasitizes other lasiocampids also.

94. *S.* (*Pimelimyia*) *semitestacea* Villen., a parasite of *G. postica* (8).

95. *Tachina fallax* Meig., a parasite of *A. lienardi* (17).

96. *T.* sp. nr. *fasciata* Fall. (Pl. II, fig. 13), a parasite of *K. junodi* (32).

97. *T. fasciata segregata* Rond., a parasite of *K. junodi* (32).

98. *T.* (*Podotachina*) *sorbillans* Wied., a parasite of *P. truncata* (11).

99. *Zygobothria inconspicua* Mg. This fly was reported (H. Taylor *in lit.*) to parasitize larvae of *A. lienardi* (17).

Family: *Tipulidae;* Crane-flies or Daddy-long-legs, Langpootmuskiete

100. *Nephrotoma* sp.

Family: *Trypetidae;* Fruit Flies, Vrugtevlieë

101. *Pliomelaena brevifrons* var. *rufiventris* Bezzi.

IV. ORDER: COLEOPTERA

Family: *Anobiidae;* Furniture or Death Watch Beetles, Gewonemeubelkewers

102. *Lasioderma serricorne* (F.). These beetles apparently destroy wattle seed in Australia. Black wattle seed received from that country contained larvae and adults and it was found that development in fact takes place within the seed.

Family: *Bostrychidae;* Auger or Shot-hole Beetles, Rondekophoutboorders

103. *Apate anceps* F. Damage by this species is done mainly by girdling the trees, which break off above the point of attack.

104. *A. indistincta* Murray (Pl. III, fig. 7). This beetle was reported to attack *Casuarina* spp., *Eucalyptus* spp., *Jacaranda mimosifolia,* and citrus trees. Lately it has been found, together with *A. anceps* (103), damaging wattles. Mainly trees up to two years old are attacked, and in older trees, the damage is confined to thinner branches.

105. *Enneadesmus forficula* Fairm.

106. *E. masculinus* Lesne.

107. *Sinoxylon* sp.

108. *S. ruficorne* Fhs. This bostrychid has lately caused considerable damage in younger wattle plantations, the attack coinciding with that of *E. pusilla* (165).

109. *Xyloperthodes incertus* Lesne.

110. *Xylopsocus sellatus* Fhs.

Family: *Cassididae;* Tortoise Beetles, Skilpadkewers

111. *Aspidomorpha tecta* Boh.

Family: *Cerambycidae;* Longhorn Beetles, Boktorre

112. *Acanthophorus* (*Tithoes*) *confinis* Cast. (Pl. III, fig. 1).

113. *Ceroplesis ferrugator* var. *marginalis* Fhs. (Pl. III, fig. 3).

114. *C. hottentota* F. Hottentot Longhorn Beetle, Hottentotboktor.
This beetle usually occurs together with *C. thunbergi* (115) and *Pycnopsis brachyptera* (118). The larvae of these species, although woodborers, develop only in moribund trees. The main damage is done by the adults, which attack younger wattle trees, stripping the succulent bark of thinner top parts. In consequence, tops are broken by wind and crowns become bushy and deformed. Ring-barking has also been observed. It is difficult to observe adults feeding, since any slight movement in their vicinity causes them to drop to the ground and sham death. Being well camouflaged, they are not easily detected on the ground among grass and litter.

115. *C. thunbergi* Fhs. Thunberg's Longhorn Beetle, Thunbergseboktor (Pl. III, fig. 9).

116. *Litopus dispar* Thoms. (Pl. III, fig. 8).

117. *Otheissa sericata* Pasc.

118. *Pycnopsis brachyptera* Thoms. Short-winged Longhorn Beetle, Kortvlerkboktor (Pl. III, fig. 10).

119. *Rhopalomeces* sp. nr. *cyanellus* Bates.

Family: *Cetoniidae;* Fruit Beetles, Vrugtekewers

120. *Agenius* (*Stripsipher*) *flavipennis* G. & P.

121. *Microlaphinis irrorata* (F.).

122. *Plaesiorrhina plana* Wied. (Pl. III, fig. 6).

Family: *Chrysomelidae;* Leaf Beetles, Blaarvreetkewers

123. *Gynandrophtalma basipennis* Lac.

Family: *Cleridae;* Clerid or Tiger Beetles, Bontroofkewers

124. *Opilio* or a related genus. Larvae belonging to this genus were found to prey on *K. junodi* (32).

Family: *Clytridae*

125. *Damia emarginata* Lac.

126. *Peploptera barkeri* Jac.

127. *P. curvilinae* Jac.

128. *Protoclytra* sp. n.

Family: *Coccinellidae;* Ladybird Beetles, Liewenheersbesies

129. *Micraspis striata* (F.).

130. *Rodalia iceryae* Janson.

Family: *Copridae;* Dung Beetles, Miskewers

131. *Onothophagus brucei* Reiche.

132. *O. cribripennis* d'Orb.

PLATE III

COLEOPTERA

1—Acanthophorus confinis (112), 2—Popillia bipunctata (186), 3—Ceroplesis ferrugator (113), 4—Catamonus melancholicus (140), 5—Eunidia pusilla (165), 6—Plaesiorrhina plana (122), 7—Apata indistincta (104), 8—Litopus dispar (116), 9—Ceroplesis thunbergi (115), 10—Pycnopsis brachyptera (118), 11—Eulepida mashona (171), 12—Hypopholis sommeri (173), 13—Hypopholis vittata (174), 14—Monochelus calcaratus (176), 15—Schizonycha sp. (181), 16—Colasposoma flavipes (153), 17—Vutsimus chrysomeloides (190).

Approximately natural size.

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Family: *Cupesidae*

133. *Cupes capensis* Kolbe.

Family: *Cryptocephalidae*

134. *Cryptocephalus africanus* Jac.

135. *C. angustofasciatus* Jac.

136. *C. intermedius* Suff.

Family: *Cryptophagidae;* Silken Fungus Beetles, Syglansswamkewers

137. *Cryptophagus* (*Micrambe*) *Kolbei* Grouv. These beetles live mainly on decaying litter and fungi, but specimens were found damaging black wattle seed received from Australia. Development of these beetles, however, does not take place within the wattle seed.

Family: *Curculionidae;* Snout Beetles, Weevils, Snuitkewers

138. *Asynonychus godmani* Crotch. Fuller's Rose Beetle, Fullerserooskewer. This curculionid was observed to defoliate young trees and wattle undergrowth, though the damage done was not on a large scale.

139. *Auletobius decipiens* Lea. This species, which has been observed to damage shoots of young wattles, has been reported from New South Wales, South Australia, and Tasmania, but until 1956 had not been recorded in Southern Africa. Nothing is known about its life cycle in Australia or in Southern Africa, where it may have been introduced from Australia through seed. This beetle is not a pest in Australia (Chief, Division of Entomology, C.S.I.R.O., Canberra, *in lit.*) and it has been suggested (Sir Guy H. K. Marshall *in lit.*) that it has only become so in South Africa owing to the absence of its natural enemies.

140. *Catamonus melancholicus* Boh. (Pl. III, fig. 4). This curculionid was reported for the first time in 1956 to have defoliated wattles situated along the South Coast of Natal.

141. *Ellimenistes laesicollis* Fhs. This weevil, hitherto believed to attack eucalypts only, has been observed damaging wattles by chewing the bark of thin branches. In consequence, tops are broken off and crowns become deformed. The life cycle is unknown, but there seem to be several generations per year, since adults may be found the whole year round.

142. *Protostrophus lugubris* Mshl. This species, which has previously been recorded only as a pest of cotton seedlings, has now been observed attacking wattle seedlings.

Family: *Dasytidae*

143. *Astylus atromaculatus* Blanch.

Family: *Dermestidae;* Hide Beetles, Velkewers

144. *Anthrenus verbasci* L.

145. *Attagenus hottentottus* Guér.

Family: *Discolomidae*

146. *Notiophygus nigropunctatus* Gory.

Family: *Elateridae.* Click Beetles, Kniptorre

147. *Agriotes* spp. Wireworms. These beetles, not hitherto observed to do damage in wattles, were found in 1957 to have destroyed wattle seedlings over approximately 100 acres in plantations in Southern Rhodesia.

148. *Cardiophorus binotatus* Boh.

149. *Cardiotarsus philauthus* Cand.

150. *Propsephus apiculatus* (Boh.).

Family: *Erotylidae;* Pleasing Fungus Beetles, Helderkleurigeswamkewers

151. *Diphyllus clavatus* Arr. This beetle, which hitherto had been thought to be a fungus feeder, was found to prey on *K. junodi* (32).

Family: *Eumolpidae*

152. *Colasposoma amplicolle* Lef. This insect has recently been reported to have defoliated 2–3 year old wattles in Southern Rhodesia.

153. *C. flavipes* Hav. (Pl. III, fig. 16).

154. *C.* sp. nr. *foveatum* Jac.

155. *Colasposoma* fulgidum* Lef. Iridescent Wattle Beetle (formerly Chrysomelid), Wattelgroenkewer.

156. *C.* semihirsutum* Jac. Green Wattle Beetle (formerly Chrysomelid), Groen-wattelslak.

These beetles (153–156) from time to time invade wattle plantations in large numbers, defoliating trees up to one year old. Outbreaks of these insect pests usually coincide with those of wattle chafers and the combined damage may be considerable.

Family: *Galerucidae*

157. *Monolepta allardi* Wse. Brown-headed Wattle Galerucid, Wattelblaarkewer. This beetle was observed for the first time in 1952 to invade and injure young wattle trees over a considerable area. Damage was aggravated because it coincided with a moderate froghopper attack. Injuries result from the insects chewing the young, succulent tips, which wilt and break off.

158. *M. apicolis* Sahlb.

159. *Platyxantha incomta* Wse.

Family: *Gyrinidae;* Whirligig Beetles, Draaikewers

160. *Aulonogyrus marginatus* (Aubé).

161. *Dineutus africanus* Aubé.

Family: *Halticidae;* Flea Beetles, Vlooikewers

162. *Esperia intermedia* Jac.

Family: *Lagriidae;* Cotton Beetles, Katoenkewers

163. *Lagria semiflava* Burm.

164. *Lagria villosa* F. (= *Lopholagria villosa* F.). These beetles prey on *K. junodi* (32).

Family: *Lamiidae*

165. *Eunidia pusilla* Dist. (= *E. strigata* Fhs.) (Pl. III, fig. 5). This longhorn beetle has damaged trees up to 20 feet high. It was usually found together with *S. ruficorne* (108).

Family: *Lycidae;* Net-winged Beetles, Platvlerkkewers

166. *Lycus* (*Lopholycus*) *zonatus* Fhs.

Family: *Melolonthidae* (*Scarabaeidae*)*;* Chafers or Cockchafers, Miskruiers

167. *Anomala caffra Burm.* Kaffir Chafer, Kafferkewer, Wattelbruinkewer. This species is fairly abundant and usually occurs together with other wattle chafer species.

168. *A. exitialis* Pér.

169. *A.* sp. nr. *pinguis* Pér.

170. *A. resplendens* Fhs. The Shiny Chafer, Blinklentekewer.

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* When the first two species of this genus to be examined by the Institute were submitted to the Commonwealth Institute of Entomology for identification, the genus was classified as *Chrysomelidae*. Later advice, however, places it in the family *Eumolpidae*.

171. *Eulepida mashona* Arrow. Mashonaland Chafer (Pl. III, fig. 11). Larvae of this beetle, hitherto supposed in Rhodesia to attack only tobacco, tomatoes, mealies, and other arable crops, are now damaging wattles by gnawing the roots of trees up to 12 feet high and wiping out plantations over considerable areas. There is one generation per year. The adults feed mainly on the foliage of indigenous trees and a deep penetration into wattle plantations in search of food has so far not been observed. Due to the cessation of breaking up of large, compact areas of virgin land for the establishment of plantations, the chafer population is decreasing. Two diptera (81, 87) were found to parasitize this beetle.

172. *Heterochelus* sp.

173. *Hypopholis sommeri* Burm. Large Wattle Chafer, Grootwattelkewer (Pl. III, fig. 12). This beetle, well known and widespread throughout the wattle belt, appears from time to time in larger numbers and the damage then becomes serious. Larvae of "white grubs" cause the most serious injury by gnawing the roots of young seedlings and of somewhat older trees. There is one generation per year.

174. *H. vittata* Fhs. (Pl. III, fig. 13). This species usually occurs together with *H. sommeri* (173).

175. *Melinesthes umbonata* (G. & P.).

176. *Monochelus calcaratus* Burm. Small Wattle Chafer, Kleinwattelkewer (Pl. III, fig. 14). This insect is well established and very widely distributed in the wattle belt. An outbreak usually occurs together with other wattle chafers. There is one generation per year.

177. *Pachnoda rufa* de G. This beetle has been reported to damage young wattle plantations in Southern Rhodesia.

178. *Psilonychus* sp.

179. *P.* sp. nr. *grondahli* Burm. (sp. n. ?).

180. *P. groendahli* Billb.

181. *Schizonycha* sp. indet. (Pl. III, fig. 15). This species appears to be closely related to *S. carbonaria*. It has from time to time defoliated young wattles, though not over large areas. Its occurrence seems to be confined to the Vryheid–Enyati (Natal) district; so far only females have been found.

Family: *Rutelidae*

182. *Adoretus capicola* Burm. This beetle occurs together with other *Adoretus* species (183–185) and usually also with wattle chafers.

183. *A. cupreus* Arrow.

184. *A. tessulatus* Burm.

185. *A. testaceus* Fhs.

186. *Popillia bipunctata* (F.) var. (Pl. III, fig. 2).

Family: *Tenebrionidae;* Darkling or Nocturnal Ground Beetles, Toktokkies

187. *Himatismus patruelis* Bertol.

188. *Perichilus ditissimus* Pér.

189. *Psammodes scrobicollis* Fhs.

190. *Vutsimus chrysomeloides* Pér. (Pl. III, fig. 17).

191. *Zophosis inexplicata* Deyr.

V. ORDER: HEMIPTERA

Family: *Anthocoridae;* Flower Bugs, Blomwantse

192. *Cardiastethus* sp. These bugs, usually occuring together with capsids (194, 195, 198) and jassids (205, 206), do much harm by damaging seed pods of wattles.

Family: *Aradidae;* Flat or Fungus Bugs, Platwantse

193. *Neuroctemus caffer* Stål.

Family: *Capsidae (Miridae);* Leaf or Plant Bugs, Plantwantse

194. *Lygus* sp. n. This capsid usually occurs together with the insects listed under 192, 195, 198, 205 and 206.

195. *Lygidolon laevigatum* Reut. Brown Capsid, Bruinstinkbesie. These sucking insects, together with the large green jassid (205), are commonly known under the misleading collective name of "froghopper". It now appears, however, that other *Hemiptera*, notably those listed under 192, 194, 198, and 206, should also be included in that group. These sucking insects usually occur together, and damage done to wattles is similar. All can be found the whole year round in all stages on younger wattle trees, but are most common during the summer months, damaging wattles by causing much branching and temporary cessation of growth. There are several generations in one year, the main damage being done by the November–December generation; the damage, however, becomes noticeable only in the following March–April. Green wattle, *Acacia decurrens* Willd, which hitherto has been considered immune to froghopper damage, is now also being attacked.

196. *Nichomachus* sp.

197. *N.* sp. ? *neanide.*

198. *Ortholytus tabidus* (Stål.). This capsid usually occurs together with bugs listed under 192, 194, 195, 205, and 206.

Family: *Coccidae;* Scale Insects, Dopluise

199. *Ceroplastes mimosae* Sign. Mimosa or Cream Coloured Wax Scale, Doringboomwasdopluis.

200. *Icerya purchasi* Mask. Fluted Cottony Cushion Scale, Australiese Wolluis.

Family: *Coreidae;* Squash Bugs, Blaarpootwantse

201. *Anoplocnemis curvipes* (F.) (Pl. II, fig. 1). Mainly tops of trees are being attacked by this bug, resulting in damage similar to that caused by "froghopper" (195).

202. *Holopterna alata* Westw. Twig wilter, Verwelkbesie. Damage done by this species is identical to that caused by *A. curvipes* (201).

203. *Homoeocerus (Prismatocerus) auriculatus* Stål. Damage caused by these bugs is similar to that caused by insects listed under 201, 202.

204. *H. (P.) magnicornis Burm.* The damage is similar to that caused by insects listed under 201, 202.

Family: *Jassidae (Cicadellidae);* Leaf-hoppers, Bladspringers

205. *Bythoscopus cedaranus* Naudé. Large Green Wattle Jassid, Grootgroenwattelbladspringer. This jassid usually occurs together with *Anthocoridae* (192), *Capsidae* (194, 195, 198), and *Distantia* sp. n. (206).

206. *Distantia* sp. n. See 195 and 205.

Family: *Membracidae;* Tree-hoppers, Boomspringers

207. *Anchon nodicarnis* Germ. Tree Hopper, Boomspringer.
208. *Oxyrhachis latipes* Dist.

Family: *Pentatomidae;* Shield Bugs, Skildstinkbesies

209. *Agnoscelis versicolor* (F.).

210. *Bagrada hilaris* Burm. Bagrada Bug, Bagradastinkbesie. This pentatomid usually attacks plants belonging to the cabbage family, but was recently observed to damage young poplars and wattles, resulting in injury similar to that caused by "froghopper" (195).

211. *Boerias victorini* Stål. This shield bug preys on larvae of lasiocampids, noctuids, and other lepidoptera.

212. *Dalsira costalis* Germ. (Pl. II, fig. 3). This bug is a predator on lepidopterous larvae.

213. *Glypsus conspicuus* Westw. This pentatomid has been reported (H. Taylor, *in lit.*) to prey on larvae of *A. lienardi* (17).

214. *G. maestus* Germ. (Pl. II, fig. 2). This species is an important predator of lepidopterous larvae.

215. *Macrorhaphis spurcata* Wlk. (Pl. II, fig. 4). This shield bug preys on lepidopterous larvae.

Family: *Reduviidae;* Assassin Bugs, Roofwantse

216. *Vitumnus scenicus* Stål.

VI. ORDER: ORTHOPTERA

Family: *Acridiidae;* Short-horned Grasshoppers, Korthoringsprinkane

217. *Duronia chloronota* (Stål.)

218. *Locusta* (*Zonocerus*) *elegans* (Thunb.). Elegant, Soldier, or Stink Locust, Stinksprinkaan. The damage done by this locust is mainly confined to young wattles, where the thinner top parts of trees are attacked.

Family: *Gryllidae;* Crickets, Krieke

219. *Brachytrypes membranaceus* (Drury).

Family: *Gryllotalpidae.* Mole Crickets, Molkrieke

220. *Gryllotalpa africana* P. & B. African Mole Cricket, Afrikaanse Molkriek.

VII. ORDER: ISOPTERA

Family: *Hodotermitidae;* Hodotermid Harvester Termites, Hodotermitiese Grasdraertermiete

221. *Hodotermes mossambicus* (Hagen). These termites attack newly established wattle plantations from time to time and completely destroy them. In the main, trees growing on northerly and north-easterly slopes are attacked.

Family: *Termitidae;* Higher Termites, Hoërontwikkeldetermiete

222. *Macrotermes natalensis* Haviland *s.l.* This species is widely distributed in wattle plantations, doing damage by attacking mainly tap roots of younger wattles.

223. *Microtermes* sp. The damage caused by this termite is identical with that by *M. natalensis* (222).

VIII. ORDER: THYSANOPTERA

Family: *Thripidae;* Thrips, Blaaspootjies

224. *Scirtothrips aurantii* Faure. Citrus Thrips. This insect is primarily a citrus pest, but other host plants such as eucalypts and acacias have been reported. Lately, however, several hundred acres of green wattle, *A. decurrens* Willd., were badly damaged, the attack starting in December. Black wattle, *A. mollissima* Willd., however, interplanted with green wattles, was not damaged by the insects, though the thrips were equally abundant on both species. It would appear that these insects prefer green wattle, where available, the leaves of which are less pubescent than those of black wattle. Heavy spring rains seem to be detrimental to the normal development of the thrips.

IX. ORDER: PSOCOPTERA

Members of the families *Caeciliidae, Ectopsocidae,* and *Lachesillidae* of this order have been found within the bags of *K. junodi* (32), the *Ectopsocidae* predominating.

Family: *Caeciliidae*

225. *Caecilius* sp.

Family: *Ectopsocidae*

226. *Ectopsocus* sp.

Family: *Lachesillidae*

227. *Lachesilla* sp.

Family: *Psocidae*

228. *Psocus* sp.

Family: *Troctidae*

229. *Troctes* sp.

B. CLASS: ARACHNIDA

X. ORDER: ARANEAE

Of the spiders listed below, only species of the families *Argyopidae, Clubionidae, Salticidae,* and *Thomisidae* have been found preying on bagworms. Species of the other families are frequently associated with bagworms, but have not so far been observed preying on these or any other wattle insects.

Family: *Argyopidae;* Cross or Orb-webbed Spiders, Wielwebspinnekoppe

230. *Araneus nigropunctatus* Lawrence.
231. *A. strupifer* Simon.

Family: *Avicularíidae;* Trap-door Spiders, Valdeurspinnekoppe

232. *Harmacha* Simon.
233. *Spiroctenus* Simon.

Family: *Clubionidae;* Wandering Spiders, Dwaalspinnekoppe

234. *Clubiona silvicolum* Lawrence.
235. *C. pupilaris* Lawrence.
236. *Chiracantium* sp.

Family: *Lycosidae;* Wolf-spiders, Wolfspinnekoppe

237. *Pardosa* sp.

Family: *Salticidae;* Jumping Spiders, Springspinnekoppe

238. *Evophrys* sp.
239. *Menemerus* sp.

Family: *Thomisidae;* Crab-spiders, Krapspinnekoppe

240. *Monaeses* sp.
241. *Synaema imitator* Pav.

Family: *Zodariidae.* Two-lunged Spiders, Tweelongspinnekoppe

242. *Cydrela* Simon.
243. *Cydrelichus* Pocock.

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GROWERS' BULLETINS

THE RATE OF DRYING OF WATTLE TIMBER IN THE PLANTATION.

By R. A. JONES

In order to obtain some idea of the rate of moisture loss from trees after stripping, two trees lying exposed as they normally would be in a clear felled area were sampled at intervals for moisture determination. The samples were obtained by sawing slices, half to one inch thick, one foot from the base and one foot from the top of each log at each sampling. The slices were taken to the laboratory in tared polythene bags and there dried to constant weight at 104°C. It was found that the tops dried out more quickly than the bases.

The results given below are the means of pairs of slices for each sampling date:

Date of sampling	Percentage moisture		Rainfall between one sampling and the next (mm.)
	Tree A DBH 6·0″ Height 46′	Tree B DBH 4·8″ Height 45′	
29.xii.58 ..	49·1	51·5	—
12. i.59 ..	43·6	45·0	111·9
26. i.59 ..	35·0	36·6	20·0
9. ii.59 ..	35·6	36·4	92·1
23. ii.59 ..	36·8	37·1	129·8
9. iii.59 ..	32·9	32·9	34·6
23. iii.59 ..	27·4	27·9	29·8
7. iv.59 ..	22·4	22·1	4·2
21. iv.59 ..	20·7	20·5	8·1
6. v.59 ..	25·3	24·7	88·3
20. v.59 ..	29·0	27·1	179·9
15. vi.59 ..	18·3	18·3	Nil
29. vi.59 ..	15·7	16·4	Nil
27.vii.59 ..	15·0	16·8	8·0

It will be seen from the table that the trees dried out steadily and gained only a little moisture during the wet period in May.

PUBLICATIONS, 1958 – 1959

Anon .. .. *The Wattle Research Institute Report for 1957–1958 (Eleventh Year)*. Pietermaritzburg, The Wattle Research Institute, October, 1958.

Ossowski, L. L. J. .. Notes on Wattle Insects Observed during the Period 1957–1958. *Rep. Wattle Res. Inst. for 1957–1958* (1958), pp. 34–36.

Ossowski, L. L. J. .. Spraying Experiments with Insecticides against Wattle Bagworm, *Kotochalia junodi* (Heyl.). II. *Rep. Wattle Res. Inst. for 1957–1958* (1958), pp. 37–39.

Sherry, S. P. .. .. Report on a Tour of Black Wattle Areas in Australia. *Rep. Wattle Res. Inst. for 1957–1958* (1958), pp. 28–33.

Copies of the above publications may be obtained on application to the Institute. The following report on work carried out under the South African Wattle Growers' Union Timber Research Fellowship at the National Chemical Research Laboratory is also available on request.

Parrish, J. R. .. .. Particle Board from Wattle Wood and Wattle Tannin. *J.S. Afr. For. Ass.* No. 32 (1958), pp. 26–31.

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